Chapter 3
Existing Condition, Affected Environment, and Environmental Effects

(3.1) Introduction

This chapter presents an analysis of the effects the actions would have on the environment under each alternative. The environmental effects are discussed together with the existing condition for each resource area. The information and data used to develop this chapter are available in the Planning Record. The Planning Record is available for review at the Baldwin-White Cloud Ranger District.

(3.2) Biological Resources

(3.3) Woody Vegetation

(3.3a) Existing Condition and Resource-Specific Information

Cover Types, Age Classes, and Species

The vegetation of the Project Area is dominated by large areas of black, northern pin, and white oaks, red and white pines, aspen, and upland openings; riparian forests, dominated by red maple, are also common. Other trees associated with these oaks and pines include quaking aspen, big-toothed aspen, and red maple. Hemlock, green and black ash, and northern white cedar are found in riparian forests, and are less frequent in the Project Area. Most of the conifer and oak stands were established 20 to 110 years ago by natural regeneration (oaks) or planting (pine). Non-forested areas, especially savannas and barrens and upland openings, have declined since 1930 because of tree planting and tree encroachment (natural succession), in conjunction with fire suppression. Age classes greater than 60 years are frequent for two reasons: (1) most individual oak stands were regenerated between 1890 and 1910, and (2) the majority of pines (capable of ages exceeding 200 years) were planted 20 to 70 years ago. The current age class distribution is displayed in Table 3.1, Acres of Forest Types by Age Class 2009, and Figure 3.1, Acres of Forest Type 2009. The vertical structure of forested areas is predominantly even-aged, where dominant trees have similar diameters, heights, and ages in any particular stand. Seedlings and saplings are numerous in younger forested locations, but one canopy layer still predominates over shorter or taller canopy layers.

The shrub layer of forested areas is dominated by witch hazel, juneberry, oak and red maple regeneration, and blueberry. A variety of herbaceous species are found in the understory of forested stands. In addition to the dominant and frequent tree species, the understory vegetation of forested stands also includes: hophornbean, hawthorn, jack pine, musclewood, raspberry, blackberry, huckleberry, and maple-leaved viburnum. Herbaceous vegetation in the closed canopy areas is similar to that found in the openings, with fewer occurrences and lower

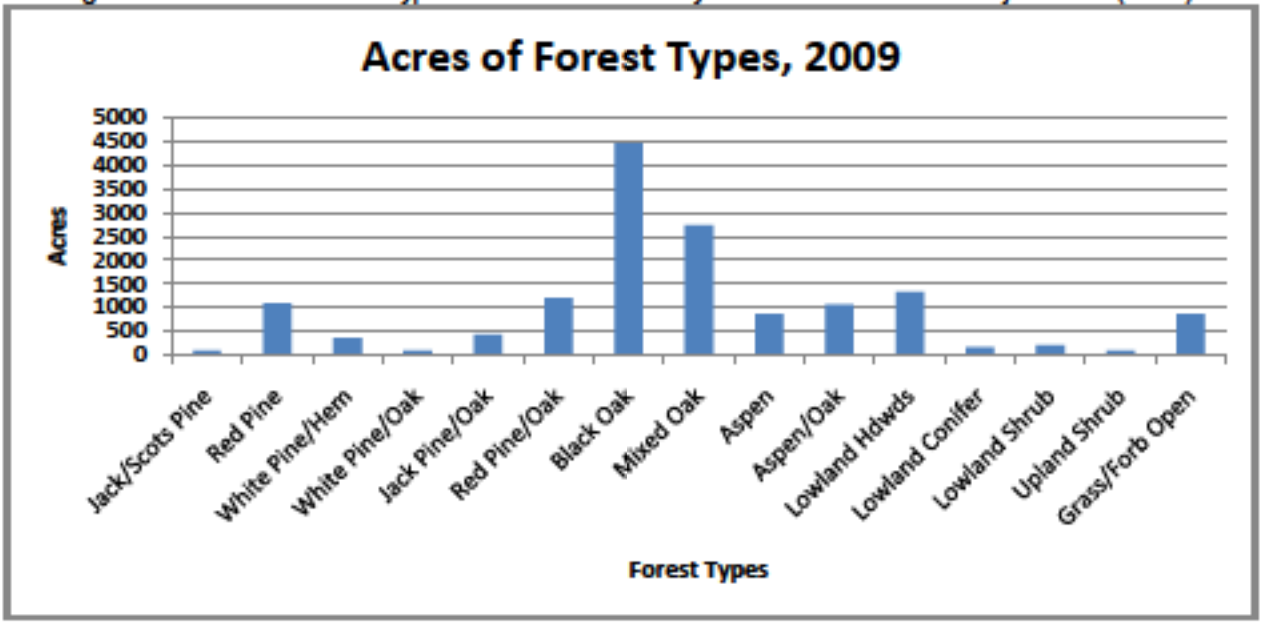
densities of warm season grasses. Species associated with the low-site oak forests may also include: pipsissawa, bear-berry, and toadflax. Oak stands typically are dominated by bracken fern, Pennsylvania sedge, wintergreen, poverty oatgrass, blueberry, and oak seedlings. Some species associated more commonly with oak forests, but not found frequently in the openings, included: pipsissawa, bear-berry, and squawroot. Pennsylvania sedge, bracken fern, and grass species predominate in the non-forested uplands. Various sedge, bullrush, grass, and fern species are common in the non-forested wetland areas.

Table 3.1: Acres of Forest Types by Age Class, 2009 (National Forest System Lands Only)

Forest Type	Group	Age Class: 2009												Total Acres	%
		0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110+	No Age		
Jack/Scots Pine	1					67	9	11						87	0.6
Red Pine	2			266	64	387	129	173	73					1,092	7.3
White Pine/Hem	2						42	249		34		31		356	2.4
White Pine/Oak	2											86		86	0.6
Jack Pine/Oak	3			76	128	124		100						428	2.9
Red Pine/Oak	3			667	86	77	300			71				1,201	8.0
Black Oak	4			200	103	8		202	224	675	92	2,965		4,469	29.8
Mixed Oak	4		9	32	41			265	205	76	265	1,844		2,737	18.2
Aspen	5		278	99	287	71	16	27	59	22				859	5.7
Aspen/Oak	4		48	417	37	14			363	13	40	123		1,055	7.0
Lowland Hdwds	6		18						13	86	517	697		1,331	8.9
Lowland Conifer	7								10		52	99		161	1.1
Lowland Shrub	8												196	196	1.3
Upland Shrub	8												98	98	0.7
Grass/Forb Open	8												856	856	5.7
Subtotal		**0**	**353**	**1,757**	**746**	**748**	**496**	**1,027**	**947**	**977**	**966**	**5,845**	**1,150**	**15,012**	**100.0**

Acres are rounded from GIS data; minor cover types are combined with associated forest cover types.

Figure 3.1: Acres of Forest Type on National Forest System lands within the Project Area (2009)



Groups of Similar Vegetation

The Forest Plan provides vegetation composition objectives for 2016, based on the natural capability of the land, for the desired amounts of vegetation classes on all Manistee National Forest lands. These amounts are displayed in Table 3.2, Desired, Existing, & Project Area Vegetative Composition Objectives. In comparing these objectives to the existing condition within the Project Area, northern hardwoods (sugar maple, beech, and yellow birch), short and long lived conifers (jack, red and white pines), and aspen/paper birch are under-represented; low and high site oaks (black, white, and northern pin oaks) are over-represented; openings (including managed openings < 10 ac.) and lowland hardwoods and conifers (red maple, green and black ash, and northern white cedar) are adequately represented. Northern hardwoods and aspen are under-represented because of the low soil fertility on the National Forest System lands in the Project Area. Low site oaks, which include areas inter-planted with red pine, and high site oaks, which include areas inter-planted with white pine, are over-represented because the majority of National Forest System lands in the Project Area are well-suited to those species associated with these Vegetative Classes.

For this project, special emphasis is given to barrens and savannas. These are non-forested lands ranging in size from 10 to 200+ acres and having a fire-dependant vegetative community characterized by widely spaced, open-grown trees. Associated understory vegetation is dominated by various herbaceous and shrub species that are dependent on frequent surface fires and are relatively shade intolerant. Barrens and savannas are located on droughty, infertile sandy soils, and were located in Oceana County on outwash plains circa 1815 – 1855. After this period, these areas were converted to agricultural and/or pine and oak forests as the rural population grew within the Project and surrounding areas. Wildfire suppression, beginning in the 1930's, has further allowed oak forests to encroach upon and reduce barrens and savannas to remnants in their previous locations. These remnants are associated with frost-pockets or other areas with sparse tree canopies. Herbaceous plant species associated with

savanna/barrens still occur in some of these locations, but Pennsylvania sedge, bracken fern, and non-native species dominate the ground cover. Barrens and savannas are under-represented in the Project Area; however, the soil and climate conditions are suitable for re-establishing this type of Vegetation Class.

Table 3.2: Desired, Existing, & Project Area Vegetative Composition Objectives

Vegetation Class	Forest Plan Desired in 2016	Forest Plan Manistee NF Existing	Project Area National Forest Lands Existing
Short-Lived Conifers	2-8%	5%	3.5%
Long-Lived Conifers	17-23%	21%	18.3%
Lowland Conifers	0-5%	2%	1.1%
Aspen/Paper Birch	10-16%	13%	5.7%
Low-Site Oaks	13-19%	15%	36.6%
High-site Oaks	15-21%	18%	18.2%
Northern Hardwoods	8-14%	11%	0.0%
Lowland Hardwoods	4-10%	7%	8.9%
Openings: Upland and Lowland Brush	4-10%	7%	7.7%
Barrens and Savannas	2-5%	1%	0%

Vegetative Characteristics of Upland Openings

Openings vary in the amount of mature trees, saplings, and shrubs. Generally, the amount of canopy cover is less than 25%, and herbaceous species are predominant but encroachment of woody plant material is a visible trend in many of the openings. Common woody species include bigtooth aspen, black oak, white oak, red pine, white pine, juneberry, black cherry, sand willow, and blueberry. Alleghany plum, a sensitive species, is also found in several locations. Many openings have a high density of Pennsylvania sedge and/or bracken fern that dominate the herbaceous layer and limit the population of other species. Native species commonly found in the Project Area include: big and little bluestem, June grass, common milkweed, hair grass, lupine, frostweed, bushclover, sweetfern, winterberry, bedstraw, flowering spurge, sweet everlasting, wild strawberry, Carolina rose, racemed milkwort, and hawkweeds. Less commonly found native forbs include: hairbell, columbine, lance-leaved coreopsis, blazing star, wild bergamot, goat's rue, Indian grass, cudweed, asters, Virginia wild rye, hoary puccoon, rice grass, jointweed, spreading dogbane, goldenrods, butterfly weed, fleabane, black-eyed susan, poverty oatgrass, woodland sunflower, self heal, poke milkweed, tick trefoil, perennial rye, several clubmosses, cats-ear, pussytoes, birdsfoot violet, bunchberry, Canadian lousewort, speedwell, Virginia dwarf dandelion, Houstonia, and the sensitive species Hill's thistle and purple milkweed. Non-native invasive species consist largely of St. Johnswort, hoary alyssum, spotted knapweed, smooth brome, white sweet clover, reed canary grass, orchard grass, burdock, yellow rocket, autumn olive, Tartarian honeysuckle, and leafy or cypress spurge.

(3.3b) Area of Analysis

The area of analysis for the direct and indirect effects on forest vegetation is the National Forest System lands where treatments will occur, and adjacent National Forest and private lands within ¼ mile of treatment sites. The area of analysis for the cumulative effects on all vegetation is the Manistee National Forest (including State of Michigan and private lands) within its proclaimed boundary. This large area represents where manipulation of similar forest ecosystems, in response to market and non-market forces, affects current and future forest vegetation patterns.

(3.3c) Direct and Indirect Effects

Cover Types, Age Classes, and Species

Alternative 1: Individual tree growth, survival, and stand dynamics (succession), would be subject to environmental and biological factors. The longer-lived upland species (oaks and pines), would tend to persist as even-aged groups and white pine would increase in the understory of many of these locations. Upland aspen and aspen-oak stands would trend towards uneven-aged oak and pine forests as individuals or small groups of aspen trees decline and die out. Riparian forests would continue to become un-even aged, as wind, flood events, and insect and disease generate opportunities for red maple, white pine and hemlock to become more widely established. The population of red maple would increase in aspen stands greater than age 80, especially in areas influenced by water tables; red maple would also increase in the understory of many oak stands located on moderately and highly productive soils. Aspen stands would be represented by a smaller range of age classes, with ages greater than 80 years converting to lowland hardwoods or mixed oaks, and age classes of 70-79 having progressively fewer mature aspen trees. Low and high-site oak stands would remain the most common forest types, and the oldest age classes (between 90 and 120 years) would still be the most frequent (USDA-Forest Service 1990).

Upland openings (< 10 acres in size) would likely decrease in both size and abundance due to encroachment by oaks and pines. This would also occasionally be influenced by natural disturbances that would promote open habitats. The dominant shrub species (black cherry, witchhazel, juneberry, and blueberry) would persist. Herbaceous ground cover would continue to be dominated by Pennsylvania sedge and bracken fern. Lowland openings would remain relatively constant in both size and abundance. These openings, because of high water tables, existing drainage patterns, infrequent fires, and windstorms, would favor willow, alder and dogwood shrubs, cattails, and carex and bulrush species. The projected age class distribution by forest type is displayed in Table 3.3, Alternative 1: Projected Acres of Forest Types by Age Class, 2019, and Chart 3.2, Alternative 1: Projected Acres of Forest Types, 2019.

There are three vegetation treatments active in the Project Area that were analyzed previously and which are on-going within the Project Area.

1. Approximately 50 acres in Greenwood Township will be converted from plantation red pine to an upland opening; supplemental treatments include prescribed fire, seeding, and planting to restore barren and savanna conditions.

2. Approximately 78 acres in Greenwood Township have been converted from red pine and oak to upland openings to evaluate the effects of varying combinations of mechanical and prescribed fire treatments on herbaceous and nectar species.
3. Approximately 346 acres in other upland opening locations within the Project Area will be treated between 2009 and 2011 to maintain open conditions and improve herbaceous diversity.

The on-going treatments are expected to provide barrens/savanna vegetation conditions by 2019.

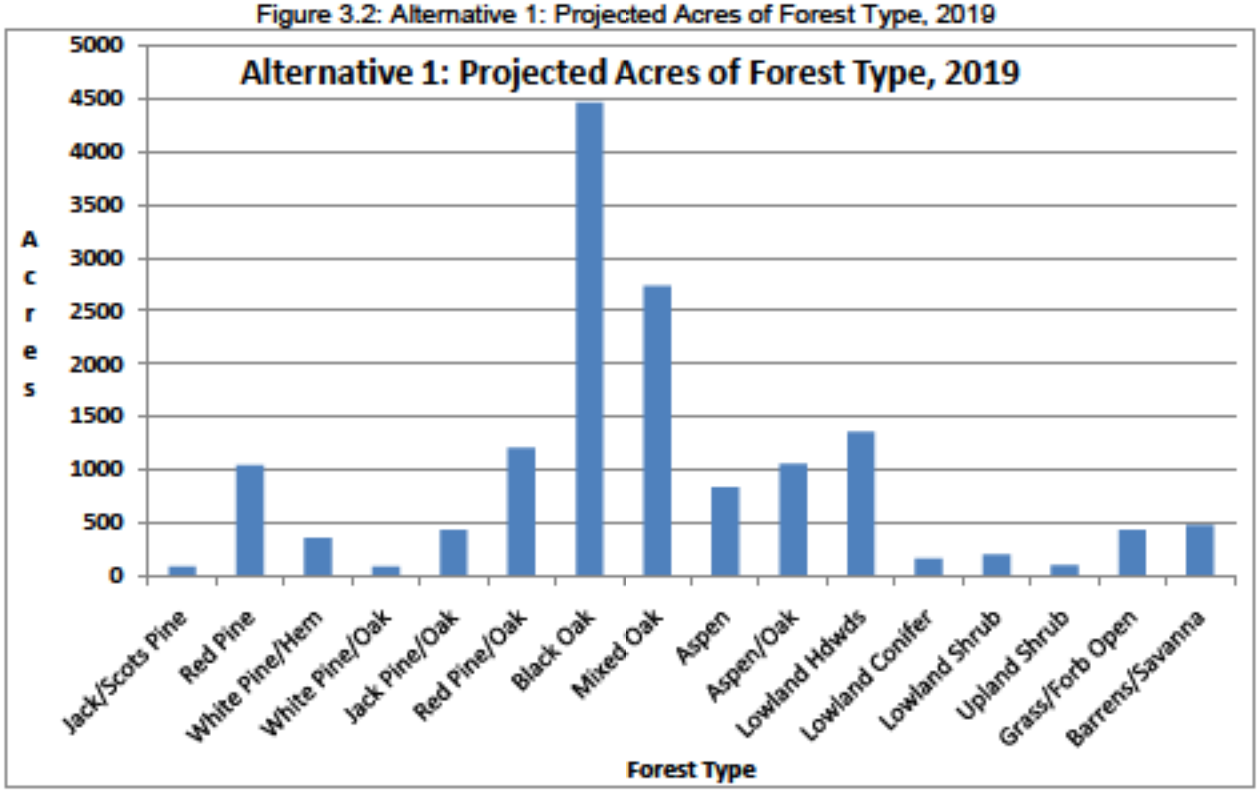
Table 3.3 (Projected Acres of Forest Types by Age Class, 2019) and Figure 3.2 (Projected Acres of Forest Type, 2019) reflects how these three active treatments affect forest cover types.

Table 3.3: Alternative 1: Projected Acres of Forest Types by Age Class, 2019
(National Forest System Lands Only)

	Age Class: 2019													
Forest Type	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110+	No Age	Total Acres	%
Jack/Scots Pine						67	9	11					87	0.6
Red Pine				266	64	387	129	173	23				1,042	6.9
White Pine/Hem							42	249		34	31		356	2.4
White Pine/Oak											86		86	0.6
Jack Pine/Oak				76	128	124		100					428	2.9
Red Pine/Oak				667	86	77	300			71			1,201	8.0
Black Oak				200	103	8		202	224	675	3,057		4,469	29.8
Mixed Oak			9	32	41			265	205	76	2,109		2,737	18.2
Aspen			278	99	287	71	16	27	59				837	5.6
Aspen/Oak			48	417	37	14			363	13	163		1,055	7.0
Lowland Hdwds	22		18						13	86	1,214		1,353	9.0
Lowland Conifer									10		151		161	1.1
Lowland Shrub												196	196	1.3
Upland Shrub												98	98	0.7
Grass/Forb Open												432	432	2.9
Barrens/Savanna												474	474	3.2
Subtotal	**22**	**0**	**353**	**1,757**	**746**	**748**	**496**	**1,027**	**897**	**955**	**6,811**	**1,200**	**15,012**	**100.0**

Acres are rounded from GIS data; minor cover types are combined with associated forest cover types.

Figure 3.2: Alternative 1: Projected Acres of Forest Type, 2019



Alternatives 2 and 3: In non-harvest areas, individual tree growth and survival, and stand succession, would be subject to environmental and biological factors. The longer-lived species (oaks, maples, pines), would tend to persist as even-aged groups. This is in contrast to aspen stands, which would trend towards uneven-age maple and oak forests as the aspen trees decline and die out. The population of red and white pine and oak species in large tree sizes would remain relatively stable. There would be increases in small size trees of these species in the areas where aspen trees are in decline. The population of red maple would increase in aspen stands greater than age 80, especially in areas of high water tables. Red maple would also increase in the understory of many oak stands with ELTP's of 20-24. Aspen stands would be represented by a smaller range of age classes, with ages greater than 80 years areas converting to lowland hardwoods or mixed oaks. Aspen age-classes of 70-79 would have progressively fewer mature aspen trees; however, aspen would increase in the 0-9 year age class, as commercially and non-commercially treated stands regenerate.

The acres of barrens would increase, as oak forests are converted to this cover type. Some upland openings (< 10 acres in size) would naturally convert to pines and oaks as efforts to remove encroaching woody stems decline. Low and high-site oak stands would remain the most numerous. The oldest age classes (between 90 and 110 years) would still be the most frequent (USDA-Forest Service, 1990). The dominant shrub species (viburnum, witchhazel, juneberry spp.) would persist, with little opportunity for early seral species (rubus and prunus species) to become established. Lowland openings would remain relatively constant in both size and abundance. This would be due primarily to the high water tables, existing drainage patterns, infrequent fires and windstorms, which would favor willow, alder and dogwood

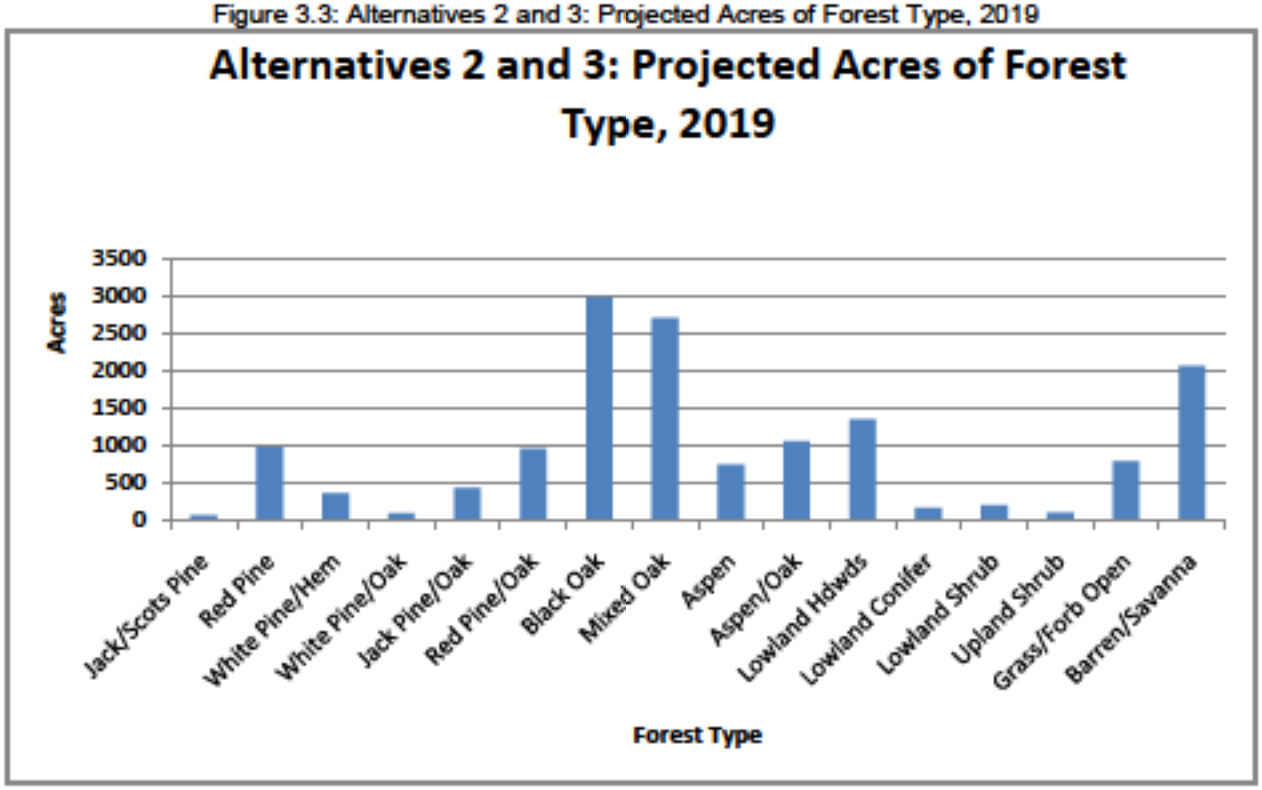
shrubs and cattails, carex, and bulrush species. Table 3.4 and Figure 3.3 display Projected Acres of Forest Types by Age Class for Alternatives 2 and 3.

Table 3.4: Alternatives 2 and 3: Projected Acres of Forest Types by Age Class, 2019
(National Forest System Lands Only)

Forest Type	Alternatives 2 and 3: Age Class: 2019												Total Acres	%
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110+	No Age		
Jack/Scots Pine						48	0	11					59	0.4
Red Pine				266	64	364	81	173	23				971	6.5
White Pine/Hem							42	249		34	31		356	2.4
White Pine/Oak											86		86	0.6
Jack Pine/Oak				76	128	124		100					428	2.9
Red Pine/Oak				518	86	77	271						952	6.3
Black Oak				100	103			67	166	425	2,129		2,990	19.9
Mixed Oak	26		9	32	39			265	205	76	2,087		2,739	18.2
Aspen			242	83	248	71	16	27					687	4.6
Aspen/Oak	50		48	417	37	14			313	13	163		1,055	7.0
Lowland Hdwds	47		18						13	86	1,214		1,378	9.2
Lowland Conifer									10		151		161	1.1
Lowland Shrub												196	196	1.3
Upland Shrub												98	98	0.7
Grass/Forb Open												788	788	5.2
Barren/Savanna												2,068	2,068	13.8
Subtotal	**123**	**0**	**317**	**1,492**	**705**	**698**	**410**	**892**	**730**	**634**	**5,861**	**3,150**	**15,012**	**100**

Acres are rounded from GIS data; minor cover types are combined with associated forest cover types.

Figure 3.3: Alternatives 2 and 3: Projected Acres of Forest Type, 2019



Principal Effects on Other Resources

Alternative 1: No new areas would be restored to savanna or barrens cover types. Except for the three areas within the Project Area where treatments are already occurring; Pennsylvania sedge and bracken fern would dominate the herbaceous layer, and suppress the remnant herbaceous component. Within the active treatment areas, the woody overstory (tree) and understory (shrub/sapling) will be reduced to an average of 5-20% and 10-25%, respectively. In these areas, wild lupine and a variety of nectar producing and savanna species will be established by planting or seeding, and non-native invasive species (NNIS) will be reduced. The three active treatments to restore savanna/barrens are approximately 559 acres in size, in 70 locations. Attaining the desired condition on these locations is expected to take ten years.

Wildlife habitats would continue a general trend from mid-seral to late-seral forest cover types. This would be accompanied by a declining amount of upland open habitat due to natural succession. Aquatic habitats would continue to be impacted by the delivery of sediment related to road crossings. Small increases of woody debris` would accrue in the waterways due to the contributions of declining large trees adjacent to riparian channels. Riparian vegetation along the North, South, and Main Branches of the White River, along with Sand and Knutson Creeks would continue to be affected by natural and human caused water level fluctuations. Exposed shorelines and eroding banks would recruit woody debris at naturally occurring rates, influencing the rate of re-vegetation by both early and late seral vegetation stages.

Forest roads would be open to non-commercial vehicle use, especially high clearance vehicles, on all locations and road segments that are not closed to motor vehicles; County roads would be

open to all licensed vehicles. Vehicle use on these roads during periods of wet weather or spring thaws would result in rutting and road widening, both of which damage the roots of adjacent trees and shrubs. Non-stabilized roadbeds would be a source of sediment deposited onto herbaceous and young woody vegetation. Some roads service historic illegal trash dumping sites and, by remaining open, would result in future trash dumping. Many illegal trash dumping sites are also sites of NNIS introduction through yard waste and from the seeds that are carried to the site on the vehicles used while dumping. The existing transportation system would not be altered, and would continue to provide vectors for the spread or introduction of NNIS species within the Project Area and between the Project Area and other public and private lands. Areas open to firewood gathering from National Forest System lands would not be changed within the Project Area. Within the WRSNA, gathering is restricted to local, subsistence (camp site use) only, and east of the North Branch of the White River and north of the Pine Point access road, gathering is regulated through the firewood permit system.

Recreation use along County and open Forest Service roads, at dispersed camping sites, and on Forest Service roads closed to motor vehicle use would result in further removal and damage to stems and roots of vegetation in both upland and riparian zones adjacent to these roads and sites. The impacts to level areas, attractive for vehicle and camper use, would likely increase over time. The locations of habitat disturbance associated with non-designated camping, equestrian and pack animals, and motor vehicle use would continue to provide disturbed habitat areas for NNIS to colonize, spread, and continue to be introduced.

Fuels reduction and air quality would not be affected by prescribed fire and mechanical equipment treatments beyond the 343 acres of broadcast and pile burning that are associated with the projects already approved by previous decisions within the Project Area. These treatments would generate particulate matter and cause a short-term decline to local air quality. Additional air quality impacts would be caused by various point and non-point sources, such as local emissions (e.g., automobile exhaust, residential wood burning) and non-local emissions (e.g., regional transport of ozone).

Alternatives 2 and 3: Large areas of oak, oak-aspen, and oak-pine forest would be restored to savanna/barrens cover types using mechanical equipment to reduce overstory canopy cover to 10–25% over 70–80% of each area, and 25–60% canopy cover over the remaining 20–30% of each area. White, black and northern pin oaks, and red and white pines would continue to dominate the overstory in these locations, accompanied by sprouts of oak and pin cherry and natural regeneration of pines. Pennsylvania sedge and bracken fern would be the dominant herbaceous species in these areas immediately afterwards. Subsequently, one or two mechanical, hand tool, or broadcast/pile burning prescribed fire treatments to reduce woody stem density (including oak and cherry sprouting) to an average of < 25% cover, would occur on these same locations. Herbicides (see Appendix C) using ground-based application methods at recommended label rates to suppress oak and cherry sprouting, carex, and bracken fern, would be used to supplement mechanical, hand tool, and broadcast/pile burning treatments to attain the desired canopy conditions. The locations proposed for these treatments surround, or are immediately adjacent to occupied KBB habitat. In addition, these locations have proportionately small amounts of understory black and white oaks than other forested locations in the Project Area, providing a more effective and efficient opportunity to restore savanna/barrens than in closed canopy oak forests and plantations having greater numbers of seedlings. Brudvig and

Asbjornsen (2009) found that woody encroachment removal is an important step in restoring Midwestern oak savannas because of the role that mechanical and prescribed fire treatments play in the reestablishment and maintenance of soil moisture gradients. The forested areas proposed for conversion to non-forest areas are generally past an age for which the culmination of mean annual increment (ft^3/ac/year) is achieved for low-site oaks (e.g., 100 years). Exceptions to the harvest of trees prior to attaining culmination of mean annual increment are permitted in deference to achieving other Forest priorities (creation of KBB habitat). The Forest Plan allows for forested areas to be converted to non-forest to provide KBB habitat within all locations proposed for such treatment.

Numerous red pine and red pine/oak plantations are proposed for mechanical thinning treatment. A few of these plantations are also proposed for hazardous fuels reduction using broadcast/pile burning treatments after the thinnings are completed. The thinnings would retain approximately 80% canopy cover dominated by pines and hardwoods of various sizes. This would be sufficient to continue the desired growth rates for another 10–20 years. Thinning treatments would continue even-age management, promoting progressively larger diameter trees in the overstory, while allowing for the development of a native understory and herbaceous layers representative of maturing conifer and oak forests. Prescribed fire treatments would enhance this canopy structure through the reduction of surface fuels (slash) and the top kill of the smaller woody stems. An acceptable range of fire intensity for the fuel types within the Project Area would be 25-200 BTU/ft/sec. Within this intensity range, heat- induced tree mortality would occur on approximately 5–10% of live trees < 8" in diameter.

Two locations of mature oak/aspen forest are proposed for treatment, using mechanical equipment to clearcut and regenerate these areas by root and stump sprouting. The understory components at these locations consist of red maple, white pine, and small oaks. The purpose of the treatments is to retain aspen within the Project Area in locations that are not likely to encroach upon potential or occupied KBB habitat. Treatments would promote an even-age structure, comprised of big-tooth aspen and white and black oaks. The understory in these areas would be sparse for the next 10–20 years, and the herbaceous layer would be dominated by bracken fern, blueberry, and Pennsylvania sedge. The two areas proposed for regeneration are over 70 years of age, and have attained culmination of mean annual increment (ft^3/ac/year). Clearcutting has been determined to be the optimum method to regenerate aspen, and is appropriate to meet the objectives and requirements of the Forest Plan.

All proposed thinnings, clearcuts, and savanna restoration treatments would be completed using commercial and/or non-commercial treatments. Locations having sufficient quantities of timber products desired by the forest product industry would be harvested under a series of contracts prepared and supervised by the Forest Service. These contracts are anticipated to be initiated and completed over the next 10–15 years, and take into consideration market demand for conifer and oak forest products, local Forest Service appropriations to prepare areas for sale, coordination of access for large trucks among sale locations, and seasonal restrictions to protect KBB populations and provide for recreational uses. Non-commercial treatments (seedbed preparation, seeding, small woody stem removal and herbicide application) for savanna and KBB habitat restoration, including those locations with insufficient quantities of timber products, would also occur over the next 10–15 years, and use either Forest Service personnel or contract labor sources. Prescribed fire treatments would also occur over the next 10–15 years,

and use Forest Service personnel to plan, conduct, and monitor these activities. Non-commercial and prescribed fire treatments would generally occur when large tree density is sufficiently reduced to proceed with activities that further develop desired forest, savanna and KBB habitat conditions; all subsequent treatments are also subject to local Forest Service appropriations and seasonal restrictions to protect KBB populations and provide for recreational uses.

Aspen would be regenerated in stands selected for treatment, with a desired density of > 2,400 stems/acre at age three. The amount of non-forest habitat would be almost doubled, while other openings would be treated to remove encroaching oaks and pines. Aquatic habitats would receive reduced levels of sediment associated with road crossings. Benefits from small increases of in-stream woody debris would occur, contributed by declining large trees adjacent to riparian channels and the addition of woody materials associated with fish structures. Riparian vegetation along the North, South, and Main Branches of the White River and Sand and Knutson Creeks would continue to be affected by natural and human caused water level fluctuations. Exposed shorelines and eroding banks would recruit woody debris at naturally occurring rates, influencing the rate of re-vegetation by both early and late seral vegetation stages.

Dead and down woody material would be partially or wholly consumed during the prescribed burning operations. Some of the dead standing trees would also be partially or wholly consumed. The structural integrity would be compromised for those that remain standing. Increased tree mortality would also occur as a result of the burning activities. This would be most pronounced in the younger age classes (0-20yr), where the tree canopies are in closer proximity to the fire front, the rooting systems are shallower and not as well established, and the outer bark surfaces are not fully developed. The level of mortality would be dependent on the age-class, species composition, and fire intensity. In areas being converted to savanna, the timing and distribution of the burning would occur to promote increased levels of fire intensity. This would cause an increase in tree mortality across all age-classes. Slash from the harvesting operations would be consumed and used as a means of carrying the fire through the burn units. Fire intensities would decrease with successive burns, as the woody material available for consumption becomes less and the fuel type slowly shifts from forested to a grassland mosaic.

Where prescribed burning would occur outside of the savanna creation areas, the timing and distribution would promote decreased levels of fire intensity. In these areas, the effects would be limited primarily to the understory. Most of the dead and down material would be consumed, with mortality limited to the younger age-classes. Through successive burns, fuel loadings would be reduced and forest types in these areas would be dominated by the more fire-tolerant species (i.e. oak). Fire scarring would be evident on the older age-class trees.

Under Alternatives 2 and 3, County roads would continue to allow licensed motor vehicles throughout the Project Area. Forest roads within the WRSNA would be closed to motor vehicles except for administrative uses. Under Alternative 3, one location in Otto Township would be seasonally closed to public motor vehicle use. Vehicle use during periods of wet weather or spring thaws on the roads remaining open to the public would result in the continued damage to the roots of trees and shrubs and promote increased levels of rutting and road widening in areas where the surface and sub-surface soils are saturated. Un-stabilized roadbeds would

continue to be a source of sediment deposited onto herbaceous and young woody vegetation; however, as closed roads become re-vegetated, less of this damage would occur. Vehicles avoiding natural obstacles on open roads would continue to increase the width of roadbeds, damaging the stems and roots of plants. Fewer roads would decrease the opportunity for illegal trash dumping and reduce the local spread and introduction of NNIS. The decreased road density in the Project Area would also reduce the number of available vectors for spread of NNIS species within the Project Area, and between the Project Area and other public and private lands. Areas open to firewood gathering from National Forest lands would not be changed within the Project Area: within the WRSNA, gathering is restricted to local, subsistence (camp site use) only, and east of the North Branch of the White River and north of the Pine Point access road, gathering is regulated through the firewood permit system.

Dispersed recreation along County and open Forest roads, especially adjacent to campsites and parking areas, would result in further removal and damage to stems and roots of vegetation. Under Alternatives 2 and 3, the roadbeds associated with the proposed road closures within the WRSNA would begin to naturally re-vegetate. Where adjacent to savanna restoration activities, roads identified as not needed for administrative purposes would be incorporated into the treatment areas and would receive a similar suite of restoration treatments. Designated camping sites, with clearing perimeters established, would reduce the ad-hoc effects of vegetation damage of indiscriminate campsite selection and modification. Overall, lower road densities would provide fewer areas where NNIS plant species are most easily established, and reduce overall NNIS treatment costs.

Under Alternative 2, there would be no access restrictions for non-motorized recreation within the WRSNA, with the exception of horse use. Within the boundaries of the WRSNA, horses would be limited to the designated non-motorized trail system and the associated facilities. As a result, the impacts from horse use on the vegetation within the Project Area under Alternative 2 would be limited to those areas that are part of, or adjacent to, the non-motorized trail system. The channeling of horse traffic to a designated trail would cause increased compaction and rutting on and adjacent to the designated trail. With increased use in these areas, the root systems of the existing woody vegetation would gradually become exposed and damaged, making the trees more susceptible to disease and windthrow. These effects would be the most pronounced on the eastern portion of the trail (adjacent to the river) and on the areas of the trail that do not occur on roads (new construction), as the existing roadbeds are typically already compacted and void of existing woody vegetation. Pronounced effects to the vegetation would be evident on the slopes and on areas where horse use occurs adjacent to the White River. Currently, the largest visual impact to the vegetation within the Project Area related to horse use is related to the damage that is associated with vehicles (parking) and camping (tethering). While this type of damage would be reduced under Alternative 2, there would be a trade-off associated with the increased damage to the vegetation caused by concentrating the horse use to one designated trail.

Under Alternative 3, there would be no access restrictions for non-motorized recreation within the WRSNA, again with the exception of horse use. There would no horses allowed within the boundaries of the WRSNA and no facilities would be provided to facilitate that form of recreational use. As a result, in comparison to Alternatives 1 and 2, there would be reduced direct and indirect effects to the woody vegetation within the boundaries of the WRSNA. This

would be most evident along the South Branch of the White River, which now receives horse use and which would be part of the designated route under Alternative 2. Due to the soil typing and the slopes in this area, the vegetation in this area is especially susceptible to the effects of compaction and erosion. With no horses allowed in this area, rutting and the associated damage to the tree root systems would be reduced.

Fuels reduction and air quality would be affected by additional prescribed fire and mechanical equipment treatments beyond the 343 acres of broadcast and pile burning previously approved in the Savanna/Barrens Restoration Project. The proposed additional treatments and ongoing treatments would generate particulate matter and cause a short-term decline to local air quality; additional air quality impacts would be caused by various point and non-point sources, such as local emissions, e.g., automobile exhaust, residential wood burning, and non-local emissions, e.g., regional transport of ozone.

(3.3d) Cumulative Effects

District records show that a variety of vegetation treatments have occurred on National Forest System lands within the Project Area between 1978 and 2009. These treatments are summarized in Table 3.5, Project Area Vegetation Treatments 1978–2009. The remaining acres of tree and shrub cutting from the three on-going projects within the Project Area (~396 acres), prescribed fire (~128 acres), and seeding and planting (~559 acres) are included in Table 3.5.

Table 3.5: Project Area Vegetation Treatments 1978 – 2010 (National Forest System Lands Only)

Treatment Types	Forested	Non-Forest, All	Aquatic
Thin and Timber Stand Improvement	794	N/A	N/A
Regenerate by Clearcut/Removal	1,826	N/A	N/A
Regenerate by Shelterwood	294	N/A	N/A
Reduce Encroaching Trees by Hand Tools, Mowing, Prescribed Fire, or Improve by Seeding, Tilling, and Planting	941	713	N/A
Stabilize Stream Banks, Placement of Woody Debris, Install Habitat Structures	N/A	N/A	208
Ongoing Vegetation Treatments	N/A	1,083	N/A

Appendix D of the Forest Plan, Proposed and Probable Practices, displays an estimate of proposed and probable silvicultural treatments for the period 2006 – 2026 in Tables D-4 and D-5. These projections have cumulative effects on the Forests' vegetation composition objectives over the next decade. Large areas of the National Forest would not be subject to active vegetation management. Together with the combined acres of projected thinning, regeneration harvests and conversion of forests to non-forest cover types, a desired vegetation composition (as displayed in Table II-3, pg. II-7 of the Forest Plan) is projected for 2016.

Alternative 1: In unmanaged forests, there would be slow accumulation of late seral forests dominated by the natural vegetation (trees, shrubs, and herbaceous species) associated with the site-specific ELTPs. There would be a trend toward uneven-aged forest structure in those locations not regenerated or maintained for non-forest cover types. Longer-lived species, such as oaks, white pine, and maples would dominant throughout the Project Area, while the number of short-lived species, such as northern pin oak, jack pine, and aspen would decrease. Areas dominated by red and white pines would retain even-age canopy structure, and reach mid- to late-seral stages of development. Jack pine and aspen areas would mature and begin to convert to early seral oak, maple, and conifer forests. Forest areas actively managed would be regenerated, primarily using even-age methods, for oaks, aspen, and pines. The dominant shrub and herbaceous species representative of site-specific ELTPs would persist, but would not be as common as in unmanaged forests. Because of the three projects that are already occurring within the Project Area, the amount of red pine and low-site oaks are expected to decrease as a result of conversion to non-forested upland openings, including barrens/savanna. Lowland hardwoods would increase as the aspen cover type declines within riparian zones through natural succession. The other forest vegetation groups would remain at current levels or fluctuate slightly, as they are still in age classes where natural conversion to other species would not be likely during this planning period. This projection excludes unpredicted occurrences such as windstorms and wildfires that affect stand level species' composition. The amount of pine thinnings, mature forest regeneration, and dead tree salvage treatments, including firewood gathering, are projected to decline from levels achieved over the past 20 years.

Infrequent insect, fire, and wind-induced mortality events would interact with other natural processes, and result in early seral forest structure and species composition only at a local scale (one to several acres, and less frequently, at scales larger than 10 acres). Lowland and riparian forests would be especially susceptible to these events. The population of ash species is likely to severely decline because of the spread of the emerald ash borer, which kills white, green and black ash trees within a few years of becoming infested. The population of American beech trees with diameters greater than 12" is likely to decline, although at a lower rate than the ash species, because of the spread of beech bark disease, which leads to mortality within 15+ years of becoming infested.

Pines and oaks would encroach on non-forested upland areas, where not actively managed. Gradually, as these species mature and continue to regenerate, the openings would become forested. The long-term exclusion of fire disturbance would enhance these effects, and would favor an increased presence of those species tolerant of less frequent fires (maples and small diameter oaks and pines, and representative ELTP shrub and herbaceous species) over those species adapted to more frequent fire events (large diameter oaks and pines and herbaceous species such as lupine and bluestem and coreopsis species). The amount and acreage of small upland openings, within areas dominated by low-site oaks and jack pine, would decline as they are incorporated into savanna/barrens habitat; however, managed upland openings and natural un-managed openings (e.g. shrub wetlands) will frequently be found intermixed within areas dominated by longer lived oaks, pines and maples.

The vegetation composition projected in 2019 for the Project Area and the desired vegetative type composition on the Manistee National Forest in 2016 is displayed in Table 3.6, Alternative 1: Change in Vegetation Class Composition. This table reflects the three on-going projects

within the Project Area. The projected amounts of forest vegetation treatments (including prescribed fire) to establish savanna/barrens on National Forest System lands could amount to approximately 20,000 acres in the next few decades. Proportionately within the Project Area, this could be 5,000+ acres. Therefore, beyond 2016, oak, pine, and aspen cover types would decline in other areas of the Manistee National Forest as these cover types are converted to savanna/barrens. In addition, prescribed fire to maintain these savanna/barrens would be used on a fraction of these acres annually.

Table 3.6: Alternative 1: Change in Vegetative Class Composition

Vegetation Class	Forests' Plan Desired in 2016	Project Area 2019	Net % Change From 2009 to 2019
Aspen – Birch	10-16%	5.6 %	-0.1%
Short-Lived Conifers	2-8%	3.5%	0
Long-Lived Conifers	17-23%	17.8%	-0.6%
High Site Oaks and Northern Hardwoods	23-35%	18.2%	0
Low Site Oaks	13-19%	36.8%	+0.2%
Lowland Hardwoods and Conifers	4-15%	10%	+0.1%
Upland and Lowland Openings	4-10%	4.9%	-2.8%
Barrens and Savannas	2-5%	3.2%	+3.2%

Landscape conditions on National Forest System lands would progress subject to the effects of non-native species on the native species. Development of private lands, especially adjacent to primary/secondary county roads, will further alter the natural landscape and become more apparent with increasing population growth and density (USDA 2007), and attendant increase for recreation access on National Forest lands.

Private lands within the Project Area are likely to be harvested for forest products, although at levels less than in the past. The most common activity would be the removal of trees > 11" in diameter and dead tree salvage harvesting. New residential and commercial building would continue to reduce the amount of total forest cover in nearly all privately owned lands immediately adjacent to National Forest lands as housing density is projected to exceed 65 units/mi^2 by 2030 (Ibid). Many private parcels are used for recreation, including ORV and horse riding, and hunting for game species. Private lands within and adjacent to the Forest boundary are also used for agriculture (cropping, pasture, orchards, Christmas trees, etc.). While the type of operation influences the type and amount vegetation present on these parcels, trends indicate that the larger parcels will continue to be sub-divided for development. These trends will not only lead to shifts in the existing land use on these parcels, but also on the amount of open space available on private lands within and adjacent to the Manistee National Forest boundary.

There are no active oil and gas exploration sites within the Project Area. The highest potential for oil and gas resources is associated with Pinnacle Reef exploration, which is located northwest of the Project Area. The subsurface rights on National Forest lands are owned by the U.S.A., State of Michigan, or private interests. Numerous oil and gas exploratory wells established in the past on National Forest lands are plugged and inactive. Two authorized oil/gas leases exist within the Project Area (Otto Township, sections 11, 12, and 27). Federal oil

and gas leases will contain a notice that precludes surface occupancy and road construction in occupied Karner blue butterfly areas; leases will also include notice that occupancy is subject to more restrictive controls than in metapopulation areas. These leases also restrict surface occupancy and use to comply with the Forest Plan Standards and Guidelines within the WRSNA and Study Wild and Scenic River corridor. No common use variety minerals are authorized within the Project Area on National Forest lands. There are active and inactive common use variety minerals (e.g., sand and gravel pits) on private lands in northern Greenwood township.

Conclusion: The duration and magnitude of no action will incrementally add to past, present, and reasonably foreseeable forest vegetation patterns within the Manistee National Forest, primarily by fostering late seral forest conditions in mature upland oak and conifer forests, and allowing immature aspen and conifer forests to mature or be replaced by mid-seral stages of oaks, maples, and conifers within the Project Area. Upland conifers and low-site oaks would likely be converted to barrens/savanna cover types elsewhere on LTA 1 within the Forest. This effect will be most pronounced on National Forest System lands. Private lands are expected to shift towards building site development and recreational uses, woodlands, and upland open uses, (e.g., unimproved pasture and game species habitat improvement).

Alternatives 2 and 3: The cumulative effects would differ from Alternative 1 principally by converting short and long-lived conifers and low-site oak cover types to non-forested cover types. The treatments proposed would change the age-class structure and species composition in individual forested stands from even-aged to non-forested canopies, the shrub and herbaceous layers would initially be dominated by oak and cherry sprouts, Pennsylvania sedge, and bracken fern. Within 10 years, a more diverse herbaceous layer and fewer tree and shrub sprouts will provide a barrens/savanna cover type within the Project Area.

Outside of the Project Area, the other cumulative effects would be similar to those described above in Alternative 1, except that fewer acres of the barren/savanna cover type would be created elsewhere on LTA 1 within the Manistee National Forest.

The projected amounts of forest vegetation treatments (including prescribed fire) to establish savanna/barrens on National Forest System lands could amount to approximately 20,000 acres in the next few decades. Proportionately within the Project Area, this could be 5,000+ acres. Therefore, beyond 2016, oak, pine, and aspen cover types would decline less in other areas of the Manistee National Forest as these cover types are converted to savanna/barrens within the Project Area. In addition, prescribed fire to maintain these savanna/barrens would be used on a fraction of these acres annually.

Table 3.7 displays the projected changes in the composition of vegetation types associated with Alternatives 2 and 3; this table reflects the three active treatments in the Project Area.

Table 3.7: Alternatives 2 and 3: Change in Vegetative Type Composition from 2009

Vegetation Class	Forests' Plan Desired in 2016	Alternatives 2 and 3 % of Project Area 2019	Alternatives 2 and 3 Net % Change From 2009 to 2019
Aspen – Birch	10-16%	4.6 %	-1.1%
Short-Lived Conifers	2-8%	3.3%	-0.2%
Long-Lived Conifers	17-23%	15.8%	-2.5%
High Site Oaks and Northern Hardwoods	23-35%	18.2%	0
Low Site Oaks	13-19%	26.8%	-9.8%
Lowland Hardwoods and Conifers	4-15%	10.3%	+0.3%
Upland and Lowland Openings	4-10%	7.2%	-0.5%
Barrens and Savannas	2-5%	13.8%	+13.8%

Conclusion: The duration and magnitude of Alternatives 2 and 3 would incrementally add to past, present and reasonably foreseeable forest vegetation patterns within the Manistee National Forest. This would occur primarily by converting upland conifer and low-site oak cover types to barrens/savanna cover types within the Project Area. Across the rest of the Forest, existing late-seral stages of forest vegetation would become interspersed with early-seral stages of aspen and non-forest areas. This effect would be most pronounced on National Forest System lands. Private lands are expected to shift towards building site development and recreational uses, woodlands, and upland open uses (e.g., unimproved pasture and game species habitat improvement). The amount of non-forest cover types on both federal and private lands will increase, but herbaceous species favorable to Karner Blue butterfly are not likely to increase proportionately on private lands.

(3.4) Herbaceous Vegetation

(3.4a) Existing Condition and Resource-Specific Information

Savanna and Karner Blue Butterfly Plant Species and Existing Conditions

Historically, approximately 10 percent (or 60,000 acres) of the Manistee National Forest was made up of some type of savanna system (HMNF Programmatic Biological Evaluation 2005). Fire was the major disturbance factor influencing the creation and maintenance of these systems, with the most open areas likely burning in successive years (Corner pers. comm. 2003c.f.; USDA Forest Service 2005). In an unaltered condition, savannas support a diverse flora including numerous species that are characteristic of dry prairies. A number of plant and animal species were reduced in frequency of occurrence and density as these communities became closed canopy forests (VandeWater 2004). The savanna ecosystem is now considered rare throughout its historic range in Michigan, with the majority having either been destroyed through land conversion or altered as a result of plant succession (Chapman, et al. 1995).

The current condition of most remaining savanna habitat in Michigan is highly degraded. Even in areas where structural characteristics may be similar to savanna conditions, species composition is highly variable and often not reflective of native floral conditions. Non-native

invasive plant species (NNIS) such as spotted knapweed (*Centaurea maculosa*), St. Johnswort (*Hypericum perforatum*), leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), white clover (*Melilotus alba*), yellow sweet clover (*Melilotus officinalis*), and smooth brome (*Bromus inermis*) have become well-established and are commonplace. These species can compete with native flora and have proven difficult to eradicate in other restoration efforts (VandeWater 2004).

Within the Project Area, native savanna flora generally occur as a small component of the overall floral in the understory of existing forested stands and as remnant patches within existing openings. Pennsylvania sedge (*Carex pensylvanica*) often dominates the herbaceous layer and is a barrier to the establishment of more diverse floral composition. In the absence of fire, Pennsylvania sedge has become well-established in many areas. This has created a monotypic thick mat that is difficult to eliminate even after fire is reintroduced to the ecosystem (VandeWater 2004).

To restore oak savannas to the Midwestern landscape, restoration efforts frequently target encroached remnants by first mechanically removing encroaching woody vegetation and later re-establishing an understory fire regime (Brudvig and Asbjornsen 2009, Packard 1997). Successful restoration depends on a careful assessment of the existing vegetation in a remnant and a careful adaptive management approach to analyzing the results of each progressive restoration action applied (Packard 1997).

The herbaceous layer is a critical element of savanna ecosystems, especially in providing nectar and food support for the insect community and the Karner blue butterfly. The presence of certain plants (e.g. "conservative" plant species found almost exclusively in this type of ecosystem) can indicate where such ecosystems were located in the past. Also, looking at current herbaceous vegetative composition can indicate the general presence or absence of desired savanna plant species' seeds in the soil seedbank. This likelihood may reflect the ease or difficulty in restoring this plant community type.

Botanical surveys were conducted within all of the stands within the Project Area being considered for any type of management activity. Areas being considered for savanna restoration activities were analyzed for the presence of savanna plants, the presence or absence of lupine, the number of 1st and 2nd flight nectar plants utilized by Karner blue butterfly, and the Floristic Quality Index (FQI). The FQI is used to assess the quality of remnant habitats and is based upon the species richness and the coefficient of conservatism or plant fidelity to a unique habitat type. Those areas with a FQI greater than 20 per ¼ m^2 are considered very high quality, while degraded remnants typically have an FQI of 5-10 per ¼ m^2 (Packard and Ross 1997). FQI values for the stands proposed for restoration in this project are based upon entire stand size and are not standardized to a ¼ m^2 survey boundary. For the basis of indicating stand richness and comparing pre- and post-treatment trends, the FQI will serve as a monitoring tool and assist in determining the adaptive treatments that would be needed.

Botanical survey results indicate that most stands identified for potential savanna restoration in this project have multiple savanna remnant nectar plants present. The density of plant species present was not uniformly sampled. Those that were surveyed for percent-perceived stand cover, and those stands which were anecdotally described, indicate that few of the stands

contain a high enough percent cover of the lupine (5-15% cover) and nectar species (5-15% cover) to provide good quality habitat for the Karner blue butterfly. A minimum of four different types of nectar plants in each flight season is needed to support Karner blue butterfly, and lupine must be present at the percent cover indicated. High quality habitat would include lupine and eight or more nectar species in each flight season. Savanna remnant indicator species found in the Project Area included: Junegrass, lupine, frostweed, hairy bush clover, racemed milkwort, Hill's thistle, Kalm's brome grass, blackseed speargrass, goat's rue, dense blazing star, and bird's foot violet. First flight nectar species present included: bastard toadflax, birdsfoot violet, Carolina rose, common cinquefoil, dewberry, frostweed, hawkweeds, ragwort, wild lupine, wild strawberry, flowering spurge, erigeron, bluets, dwarf dandelion, hoary puccoon, yarrow and lousewort. Second flight nectar species present included: black-eyed susan, blue toadflax, butterfly weed, blazing stars, daisy fleabane, dewberry, flowering spurge, goat's rue, hairy bush clover, harebell, hoary puccoon, horsemint, lance-leaved coreopsis, bluets, hawkweeds, racemed milkwort, rough blazing star, sweet everlasting, dogbane, spirea, bedstraw, common milkweed, New Jersey tea, wild bergamot, woodland sunflowers, yarrow, Hills thistle, thimbleweed, evening primroses, asters and goldenrods.

While the diversity of nectar plants in many stands is good, the abundance is below a level needed for good pollinator habitat. Emphasis would be placed on conserving the present seed bank and the existing native plant populations, while encouraging greater density of flowering nectar species. Table 3.8 indentifies the management strategies associated with supplementing the existing native nectar plants in the Project Area.

Table 3.8: Management Strategies for the Seeding of Nectar Plants

	Current Nectar Species Composition Category			
	No Lupine	**Lupine present, less than 4 nectar species in both seasons**	**Lupine present, 4-7 nectar species in both seasons**	**Lupine present, 8 or more nectar species present in both seasons**
Treatment Recommendation	Plant lupine	Plant to increase nectar species presence and treat (i.e. burn, fence) to increase population density of desired plants.	Plant to increase nectar species presence and treat to increase population density of desired plants. Plant by either over-seeding after burn or scarify/disc areas of Pen sedge and seed or plant plugs of nectar plants.	Monitor and treat to increase population density of nectar plants. Scarify/disc areas of Pen sedge and seed or plant plugs of nectar plants without disturbing current nectar plant populations.

As much as it is possible, southern Michigan native genotype plant materials will be used for savanna restoration in accordance with the Forest Service Native Plant Species Framework (2008) as indicated in the Forest Service Manual Section 2070.3 that states:

"the FS is to ensure genetically appropriate native plant materials are given primary consideration in revegetation, restoration and rehabilitation of National Forest System lands, and that genetically

appropriate plants are those genetically diverse to respond and adapt to changing climates and environment conditions; unlikely to cause genetic contamination and undermine local adaptations…and are likely to maintain critical connections with pollinators."

As noted by Schoonhoven, et. al. (2005), local genotype plant materials may be an important factor in sustaining local insect populations. The following sources will be used for seed procurement:

1. Michigan-sourced seed from a Michigan-based native plant grower (to the extent that Michigan genotype seed is available);
2. Wisconsin-sourced seed (when or if Michigan-sourced seed is not available in a sufficient supply);
3. Other western Great Lakes states sources (if Wisconsin supplies are also exhausted); and
4. Supplement plant materials collected locally on the District by contracted growers and/or limited in-house efforts.

Non-Native Invasive Plant Species

The Huron-Manistee National Forests has identified certain plants as non-native invasive species (NNIS). Each listed species has a priority ranking for treatment. The management of NNIS is important because they have the capacity to transform or dominate native plant communities, and easily become established in areas that are frequently or severely disturbed, such as road clearings, landing sites, and skid trails. Nine species found in the Project Area have been identified for herbicide or mechanical treatment within stands where treatment would likely result in an increased spread of the NNIS due to the treatment activity (Table 3.9).

Table 3.9: NNIS Control Recommendations

NNIS Species	Forest Priority[1]	Management Options	Number of Locations[2]	Number of Acres[2]	Recommended Treatments
Leafy Spurge & Cypress Spurge	3	Control	16	17	Glyphosate
Autumn Olive	4	Control	11	11	Glyphosate or Triclopyr
Honeysuckle	2	Control	4	4	Glyphosate or Triclopyr
Japanese Barberry	2	Control/Eradication	1	1	Glyphosate or Triclopyr
Garlic Mustard	2	Eradication	1	1	Glyphosate, mechanical
Multiflora Rose	2	Eradication	1	1	Glyphosate or Triclopyr
Canada Thistle	4	Control/Eradication	3	3	Glyphosate, Mechanical
Scots Pine	4	Eradication	3	3	Mechanical
		Total Estimated	**41**	**42**	

[1]Ratings of Forest Priority are levels that determine the need to focus treatment attentions on either controlling or eradicating the NNIS. This rating takes into consideration such factors as current presence on the Forest, potential of spread, and the desired habitat characteristics.

[2]It is probable that this number would be slightly larger by the time treatment occurs due to movement and increased infestation.

Leafy and Cypress Spurge: These are two closely related species that have been identified for control treatments. They are aggressive and persistent weeds that are rapidly spreading throughout the mid-western United States. There are nineteen State legislatures that classify leafy spurge as a noxious weed, primarily because it is poisonous to cattle and causes severe eye irritation and possibly blindness in humans (Czarapata 2005). Leafy spurge is a known allelopathic plant, meaning that it modifies the soil environment of the areas where it occurs. This may result in an inability of native plants to persist in the immediate area of the plants. Control of spurge is difficult and must begin prior to the establishment of desired native vegetation (Biesboer (updated by Eckhardt) 1996). No single mechanical control method (e.g. smothering, discing) has proven wholly effective at control or eradication of spurge (Czarapata 2005). However, prescribed burning, in conjunction with herbicide application, can provide effective control of leafy spurge. Burning may either precede or follow spraying, but as with other methods, repeated treatments are necessary over at least a 5-10 year period. Surveillance and reapplication of herbicide must continue for at least 10 years to assure control and eradication (Biesboer (updated by Eckhardt) 1996). Glyphosate is most effective when applied after seed set in mid-summer or in late September after fall regrowth has started, but before a killing frost.

Autumn olive: This species occurs frequently throughout the Project Area in disturbed areas, early-successional fields, pastures, landings, and roadsides. Once established, it can eliminate almost all other plant species. Originally planted for its perceived benefits to wildlife, it has since spread profusely via bird feces. The Nature Conservancy (Sather and Eckardt 1987) notes that autumn olive has the potential of becoming one of the most troublesome invasive shrubs in the central and eastern United States due to its prolific fruiting, rapid growth, wide dissemination by birds, and its ability to easily adapt to many sites. In addition, because it fixes nitrogen in the soil, it can disrupt native plant communities that require less fertile soil (Czarapata 2005). Cut-stump and stem application of glyphosate has been effective at controlling autumn olive when used as a 10-20% solution. Although the product label specifies a higher concentration for cut-stump application (50-100%), this lower concentration has proven effective (Szafoni 1990). Thin-line basal bark treatments with triclopyr have demonstrated a 95% effectiveness rate at other locations on the District.

Honeysuckle: These are not yet well established in the Project Area; however, once established, honeysuckles can displace native woody species and reduce the overall species richness of native plant communities. This includes tree regeneration in early to mid-successional forests (Batcher and Stiles 2000). These effects result from their ability to grow to large size and replace native plants by crowding or shading them out and by depleting the soil of moisture and nutrients. Some exotic honeysuckles may also be allelopathic (Czarapata 2005). In addition, natural forest regeneration following disturbance can be severely impeded by these species (Sather and Eckardt 1987). A survey in 1998, found that most land managers used a glyphosate cut stump treatment for control of honeysuckle. For cut stump treatments, 20-25% solutions of glyphosate or triclopyr can be applied to the outer ring (phloem) of the cut stem. A 2% solution of glyphosate or triclopyr can be used for foliar treatments. The use of prescribed fire may also be effective when the density is low and sufficient fuels are available (Sather and Eckardt 1987). Effective mechanical management requires a commitment to cut or pull plants at least once a year for a period of three to five years (Sather and Eckardt 1987).

Japanese and European Barberry: These are aggressive, spiny shrubs that can survive well in shade and in wet or well-drained soils. Only one location of barberry was noted in the Project Area. The plant regenerates by seed, branch tip rooting, and creeping roots. Cutting or digging plants out in the spring can be effective for small infestations and small plants. Triclopyr has been used as a cut-stump treatment (WI DNR 2010). Glyphosate may also be effective.

Garlic Mustard: This allelopathic biennial can prevent even forest tree regeneration once it becomes well established. Seeds have been reported to survive up to 10 years in the soil. Control requires annual treatments until no new plants occur (often over a period of 10–12 years). Small populations can be eradicated by hand pulling if all of the flowering plants are pulled prior to seed formation. However, even cut stem flowering plants can produce viable seed (Sheehan 2007a). Burning may also aid in control efforts (Sheelan 2007a). Herbicide application, such as glyphosate at 2%, can be very effective, though annual checks are important to prevent the establishment of satellite infestations. Populations are estimated to double in size every four years if left untreated, but disturbance can lead to a 200–1,000% increase in just one year (Sheehan 2007a).

Multiflora Rose: This woody perennial invades old fields, open prairies, forests, oak savannas, fencerows and roadsides, river banks, and prairie fens. The dense growth of the foliage and stems inhibits the growth of competing native plants (Sheehan 2001). Multiflora rose was found in only one location in the Project Area. Multiflora rose reproduces by seeds and by rooting at the tips of its drooping canes. The fruits are highly sought after by birds, with seedlings often being found under bird perch sites. Eckardt (1987 and 2001) notes that the most effective means of controlling this species includes cut stem application. Glyphosate is commonly used and can be effectively applied to the plants, cut branches, or stumps in a 0.5-1% solution. Repeated mowing will control the spread of multiflora rose, with a recommended 3 to 6 mowings or cuttings per year, repeated for 2 to 4 years (Sheehan 2001).

Canada Thistle: This is an erect rhizomatous perennial, that is distinguished from all other thistles by creeping horizontal lateral roots, dense clonal growth, and small dioecious (male and female flowers on separate plants) flowerheads (Nuzzo 1997). Canada thistle is considered the worst invasive thistle as it is a prolific seed producer (estimates range from 1,500 to 40,000 seeds per plant) and it fills disturbed ground with its rosettes (Annen 2007). There are numerous ecotypes that respond differently to management activities. Some infestations may be completely controlled by one technique, while others will only be partially controlled because two or more ecotypes are present within the population. Additionally, treatment response varies under different weather conditions. Therefore, it is often necessary to implement several control techniques, and to continuously monitor their impacts. The best option in prairies and other grasslands is to first enhance growth of native herbaceous species by spring burning, and then cut or spot treat Canada thistle with glyphosate (2.5% solution) when it is in late bud or early bloom (usually June) (Nuzzo 1997). Mechanical treatments (i.e. burning, mowing, and tilling) are most effective in June, when the root carbohydrate reserves are minimal. Mowing, done several times a year, should be repeated for several consecutive growing seasons (Annen 2007). For this project, sites with Canada thistle will have prescriptions for control which would include a combination of mechanical and herbicide treatment.

Scots Pine: This non-native tree is most often found in relatively open upland areas; however, it may also be present in mixed forests and as the major component of planted conifer stands. It spreads through seed dispersal and has an average range of 50–100 m from the parent (Sheehan 2007 b). Due to the preferred habitat characteristics of Scots pine, it may serve as threat to savanna habitat (Sheehan 2007b). Recommended control methods include girdling and shearing/herbiciding. For girdling, bark and phloem is removed from a 10 cm band around the trunk.

In addition, other HMNF NNIS species are present within, or at the edges of, stands recommended for savanna restoration. These species are generally more abundant on the Forest and are only recommended for herbicide treatment in the event that competition from these species is likely to hinder the establishment or abundance the nectar plant species required by the Karner blue butterfly. These NNIS species are listed in Table 3.10. These would only be treated when determined through monitoring that their presence or abundance poses a risk to the success of the project. Treatments would be adaptive to site-specific conditions and would include a combination of mechanical and chemical treatment methods.

Table 3.10: Herbicide Recommendations for Non-Native and Undesired Plant Species Hindering Establishment of Karner Blue Butterfly Nectar Plant Species

NNIS or Undesired Plant Species	Forest Priority[1]	Recommended Herbicide(s)
Bracken Fern	Undesired[2]	Glyphosate
Canada Thistle	4	Glyphosate
Pennsylvania Sedge	Undesired[2]	Glyphosate
Hoary Alyssum	4	Glyphosate
Orchard Grass	4	Glyphosate
Reed Canary Grass	4	Glyphosate
Smooth Brome	4	Glyphosate
Sow Thistle	5	Glyphosate
Spotted Knapweed	4	Glyphosate
St. John's Wort	4	Glyphosate
Queen Anne's Lace	4	Glyphosate
White Sweet Clover	4	Glyphosate

Table 3.10 (continued): Herbicide Recommendations for Non-Native and Undesired Plant Species Hindering Establishment of Karner Blue Butterfly Nectar Plant Species

Yellow Rocket	4	Glyphosate
Yellow Sweet Clover	4	Glyphosate
Woody Stump Sprouts	Undesired Sprout[3]	Glyphosate, Triclopyr, or Imazapyr

[2]Ratings of Forest Priority are levels that determine the need to focus treatment on either controlling or eradicating the NNIS. This rating takes into consideration such factors as current presence on the Forest, potential of spread, and the desired habitat characteristics.

[2]Undesired plants are those native plants known to be highly aggressive and have been shown on the Forest, and around the region, to form thick covers preventing the establishment or abundance of other desired native species. These species would not be treated for elimination from a stand, but would be treated in patches to allow for greater abundance of other desired Karner blue butterfly nectar species and increased species richness.

[3]Undesired sprout includes the herbicide stump treatment of trees, especially oaks, cut to open up canopy cover and restore/create savanna habitat for Karner blue butterfly. In cases where timber cuts and burns are not sufficient to remove individual trees, stump application may be applied.

An additional strategy to prevent and limit the spread of all of the Forests' identified NNIS species is to pre-treat harvesting equipment (cleaning of mud, debris, etc.). For this project, this would occur in areas where ground disturbing treatments could potentially introduce or increase the spread of these species. The target species for pre-treatment activities include: yellow rocket (*Barbarea vulgaris*), hoary alyssum (*Berteroa incana*), smooth brome (*Bromis inermis*), spotted knapweed (*Centaurea biebersteinii [maculosa]*), Canada thistle (*Cirsium arvense*), orchard grass (*Dactylis glomerata*), Queen Anne's lace (*Daucus carota*), autumn olive (*Elaeagnus umbellata*), St. Johns wort (*Hypericum perforatum*), white sweet clover (*Melilotus alba*), and reed canary grass (*Phalaris aurundinacea*). The list of target NNIS would be expanded in the areas of Karner blue butterfly habitat creation or restoration. The matrix summarizing equipment cleaning by stand is located in the Project File (Baldwin Ranger District).

In addition, areas that are seeded or planted with native nectar species will need to be monitored for the presence of NNIS for 3 to 5 years following the seeding or planting. It is expected that hand pulling of weeds in seed plots would effectively eliminate NNIS problems in native seed beds in most cases as long as hand-pulling occurs prior to seed dispersal by the invasive plant species. In cases of seeding failure, stands may need to be retreated and reseeded to eliminate creation of a stand dominated by NNIS species.

Threatened/Endangered/Regional Forester Sensitive Plant Species

Field surveys were conducted in the SER project area during the 2006 through 2010 field seasons. During these surveys, no Federally Threatened or Endangered plant species were found. It is not expected that any occur within the Project Area.

Regional Forester Sensitive Species (RFSS) are species listed by the Regional Forester that have a national or state ranking of 1–3, have potential habitat or populations on the Forest, and are shown by Risk Evaluation to be at risk. RFSS found within the Project Area included Alleghany

plum *(Prunus alleghaniensis var. davisii)*, purple milkweed *(Asclepias purpurea)*, and Hill's thistle *(Cirsium hillii)*. Table 3.11 identifies those locations where RFSS were found in the Project Area during field surveys.

Table 3.11: Regional Forester Sensitive Species Identified in the Project Area

Regional Forester Sensitive Plant Species	Compartment	Stand(s)
Alleghany Plum *(var. davisii)*	414	35, 41, 43, 44, 46, 59, 60
	416	5, 13, 42, 44, 50, 54, 55
	418	65, 82, 92, 117, 120, 130
	422	8, 17, 19
	458	17, 18, 21
Hill's Thistle	414	41, 43, 44, 46, 50, 59, 60
	416	7, 8, 9, 13, 32, 36, 44, 50, 52, 53, 55
	439	4, 10, 42
	458	25, 41, 45
Purple Milkweed	438	24, 63

Several other rare plants or species of concern have been found during other periods of observation within or close to the Project Area (MNFI database 2010). These species include: black-fruited spike-rush (*Eleocharis melanocarpa*, State Special Concern), prairie smoke (*Geum triflorum* - State Threatened, RFSS), bastard pennyroyal (*Trichostema dichotomum*, State Threatened, RFSS), false pennyroyal (*Trichostema brachiatum*, State Threatened, RFSS), bald-rush (*Rynchospora scirpoides*, State Threatened, RFSS), dwarf bulrush (*Hemicarpha micrantha*, State Special Concern, RFSS), purple spike rush (Eleocharis atropurpurea – State Endangered, RFSS), Tall Beak-rush (*Rhynchospora macrostachya*, State Special Concern), Whorled Mountain mint (*Pycanthemum verticillatum*, State Special Concern, RFSS), tall green milkweed (*Asclepias hirtella*, State Threatened), umbrella grass (*Fuirena pumila* – State Threatened, RFSS), Wahoo (*Euonymus atropurpurea* – State Special Concern), prairie dropseed (*Sporobolus heterolepis*, State Special Concern, RFSS), tall nut rush (*Scleria triglomerata*, State Special Concern, RFSS), and Vasey's rush (*Juncus vaseyi*, State Threatened, RFSS).

In addition to sensitive plants which have been found within or close to the Project Area, there are also habitats present that have the potential to support other sensitive species. Table 3.12 lists plant RFSS for the HMNF and indicates whether habitat(s) exist in the Project Area for that species.

Table 3.12: Habitat Determinations within the Project Area for Regional Forester Sensitive Species

Scientific Name	Common Name	Habitat	Code*
Agoseris glauca	pale agoseris	Prairies and jack pine/savannas with calcareous gravelly subsoils	1,2,3
Ahtiana aurescens	yellow ribbon lichen	Near bogs or water in old-growth forests on cedar, pine, or occasionally hardwoods.	1,3
Amerorchis rotundifolia	small round-leaved orchid	Northern boreal forests, bogs, cedar swamps, moors	2,3
Arabis missouriensis	Missouri rock cress	Oak or pine savannas/barrens; also found in wet, alkaline habitats	Y

Scientific Name	Common Name	Habitat	Code*
var. deamii			
Armoracia lacustris	lake cress	Quiet water or muddy shores, rivers, and lakes, especially in cold spring-fed water	2,3
Asclepias purpurascens	purple milkweed	Oak/pine barrens, prairies, shrub thickets, roadsides	Y
Aster sericeus	Western silvery aster	Prairies, dry banks, and fields	Y
Astragalus canadensis	Canadian milkvetch	Dry prairies, moist shores, river banks, marshy ground, other open or partially shaded ground	Y
Botrychium oneidense	Oneida grape fern	Moist, shady, acidic woods and swamps; hardwoods; canopy openings and treefall gaps	2
Botrychium rugulosum	ternate grape fern	Open fields, secondary forests	Y
Bouteloua curtipendula	side-oats grama	Oak barrens, dry grassy openings	Y
Carex lupiliformis	false hop sedge	Swales, marshes, swamps, floodplain forests, woodland depressions	Y
Carex schweinitzii	Schweinitz's sedge	Shaded streambanks	Y
Castanea dentate	American chestnut	Dry to mesic oak-hickory forests	Y
Cirsium hillii	Hill's thistle	Oak/pine barrens, prairies, grassy openings	Y
Cladonia robbinsii	yellow tongue cladonia	Soil and soil-covered rocks in open woods, roadsides, and fields	1
Cynoglossum virginianum var. boreale	Northern wild comfrey	Mixed forests, edges, openings	Y
Cypripedium arietinum	ram's head lady-slipper	Cedar swamps and lowland conifers in south/central Michigan	2,3
Dalibarda repens	false-violet	Moist, acid duff within mature pine stands; usually in undisturbed mesic/wet soils under full canopy	2,3
Dryopteris goldiana	Goldie's wood fern	Dense moist woods, especially ravines, limey seeps, or edges of swamps	2,3
Eleocharis atropurpurea	purple spike rush	Coastal plain marshes, moist acid sands	2,3
Eleocharis engelmannii	Engelmann's spike rush	Wet depressions, coastal plain marshes	2,3
Eleocharis tricostata	three-ribbed spike rush	Coastal plain marshes, moist acid sands	2,3
Eupatorium sessilifolium	upland boneset	Oak barrens, oak stands	Y
Festuca scabrella	rough fescue	Jack pine barrens, dry northern forest, often associated with calcareous, gravelly subsoils	1
Fuirena squarrosa	umbrella-grass	Coastal plain marshes, moist acid sands	2,3
Geum triflorum	prairie smoke	Oak woodland bluffs, sandy prairie, thin soil over limestone	Y
Heterodermia obscurata	orange-tinted fringe lichen	On hardwoods; old-growth indicator	2,3

Scientific Name	Common Name	Habitat	Code*
Huperzia selago	Northern fir-moss	Lakeshore swales, conifer swamps, rocky shorelines and outcrops, open dunes, calcareous seeps	2,3
Hypericum gentianoides	orange grass or Gentian leaved St. John's-wort	Sandy acid wet or dry soils, at edges of damp wet prairies, open habitats	2,3
Juglans cinerea	butternut	Floodplains, hardwood stands, homesteads, swamp forests	Y
Juncus brachycarpus	small-headed rush	Moist/wet meadows and shores on mineral or organic soils	2,3
Juncus vaseyi	Vasey's rush	Moist/wet meadows and shores on mineral or organic soils	2,3
Kuhnia eupatorioides	false boneset	Dry, open areas, prairies	Y
Lechea pulchella	Leggett's pinweed	Prairies, undisturbed openings	Y
Linum sulcatum	furrowed flax	Dry, open sandy soils and prairie remnants	Y
Liparis lilifolia	lily-leaved twayblade	Subirrigated sands under conifers or hardwoods, wet shrubby thickets	2,3
Liphocarpha micrantha	dwarf bulrush	Exposed wet/moist sands associated with coastal plain marshes, lakeshores	2,3
Lycopodiella subappresssa	Northern appressed club-moss	Lake plain prairies, interdunal wetlands, wet open ground (disturbance)	2,3
Malaxis brachypoda	white adder's-mouth	Sphagnum bogs, moist hardwoods/cedar stream banks	2,3
Mertensia verginica	Virginia bluebells	Wooded floodplains	2,3
Orobanche fasiculata	Fasicled broom-rape	Dunes and dry/wet interdunal areas	2,3
Panax quinquefolius	American ginseng	Mature hardwoods mixed aspen/hardwoods with rich soil	2,3
Poa paludigena	bog blue grass	Bogs, acidic swamps	2,3
Polygala cruciata	cross-leaved milkwort	Intermittent wetlands coastal plain marsh, exposed water tables	2,3
Potamogeton bicupulatus	waterthread pondweed	Ponds and marshes	2,3
Prunus alleghaniensis var. davisii	Alleghany plum	Openings, old fields, prairies, roadsides	Y
Psilocarya scirpoides	bald-rush	Marly bogs, grassy swales, coastal plain marshes	2,3
Pterospora andromedea	pine-drops	Pine stands, hardwood stands	Y
Pycnanthemum pilosum	hairy mountain-mint	Undisturbed upland oak, old fields, openings, roadsides	Y
Pycnanthemum verticillatum	whorled mountain mint	Sand shorelines, coastal plain marsh, exposed water tables	2,3
Rhexia virginica	meadow-beauty	Intermittent wetlands, coastal plain marshes and coastal plain marsh complexes	2,3

Scientific Name	Common Name	Habitat	Code*
Scirpus hallii	Hall's bulrush	Sandy lakeshores, coastal plain marshes	2,3
Scirpus torreyi	Torrey's bulrush	Muddy or sandy lakeshores, peaty or mucky edges of marshes	2,3
Scleria pauciflora	few-flowered nut-rush	Coastal plain marshes, moist acid sands	2,3
Scleria triglomerata	tall nut-rush	Wet prairies, coastal plain marshes	2,3
Sisyrinchium atlanticum	Atlantic blue-eyed grass	Coastal plain marshes, moist sandy shores, wet prairies	2,3
Sporobolus heterolepis	prairie dropseed	Calcareous fens, prairie wetlands	2,3
Taxum Canadensis	Canadian yew	Rich, often swampy woods; dunes	2,3
Trichostema brachiatum	false pennyroyal	Calcareous soils, old fields, openings, dry prairies, roadsides, rights-of-way, occasionally disturbed sites	Y
Trichostema dichotomum	forked bluecurls or bastard pennyroyal	Old fields, open habitat in oak/pine barrens, prairies, openings	Y
Triplasis purpurea	purple sandgrass	Sandy openings	Y
Viola novaeangliae	New England violet	Gravelly and sandy shores, mesic sand prairies, rock crevices along waterways	2,3

** **Code**: The species was <u>not</u> included in this assessment because:*

1. *The species has not been documented to occur on the Manistee National Forest,*
2. *The species is found in habitat(s) unlike those found in the proposed Project Area,*
3. *The species was not found during field surveys of the proposed Project Area and/or there are no known records of the species in the Project Area,*

Y (Yes): The Species was included in the assessment either because the species was found during field surveys; a past record has indicated the species presence in the Project Area; or the habitat for the species exists within the Project Area.

(3.4b) Area of Analysis

The area of analysis for the direct and indirect effects on the herbaceous vegetation is the National Forest System lands where treatments would occur, and adjacent National Forest and private lands within ¼ mile of treatment sites. This area represents a reasonable distance for plant seed dispersal. The area of analysis for the cumulative effects is the southern and middle portions of the lower peninsula of Michigan. This area has been identified due to the similarities across this region relative to growing conditions, plant species composition, and the impacts related to human activities.

(3.4c) Direct and Indirect Effects

Effects on Savanna and KBB Plant Species

Timber Harvesting: Under Alternative 1, no timber harvesting would occur. Disturbance would be limited to that of natural origins such as wildfire or wind throw. Oak stands would continue to mature and areas of more open lands would continue to fill in with woody vegetation. As aspen stands continue to age and decline, other woody species would begin to replace aspen as the dominant cover type. For savanna species that are light dependant, continued maturing of forested lands would likely result in declining savanna nectar plant species.

Under Alternatives 2 and 3, timber harvesting would occur in the form of pine thinning, scotch pine removal, oak/pine cuts for savanna restoration (discussed in the next section), and oak/aspen clearcutting. Savanna and KBB nectar plant species require generally open conditions. While the canopy would decrease in the short-term following timber harvest, open conditions would not persist for any real net increase in savanna/nectar plant habitat availability without continued management efforts such as prescribed burns to maintain openness. In some forested stands, however, KBB nectar plants are currently present and would be expected to increase in the short-term with an increase in canopy openings. In addition, some KBB nectar plants are also non-native plants with an early-successional pioneer strategy. It is likely that these species (such as hoary alyssum, the hawkweeds, spotted knapweed, and St. Johnswort) would become established in the newly opened areas. Studies suggest that openings or corridors within forested stands can support Karner blue butterflies if lupine and other nectar species are present (Kleintjes, et al. 2003). In areas already populated by KBB, an increase in lupine and nectar plant presence in a heterogeneous habitat setting would provide a close proximity of shade plus lupine/nectar.

Savanna Restoration: Under Alternative 1, no treatment would occur. The only disturbance occurring would be that of natural origin such as wildfire or wind throw. Plant succession would continue to progress, woody vegetation would continue to dominate the landscape in forested areas, and would continue to encroach upon, and expand within, openings. Biodiversity of fire-dependant savanna herbaceous plants would continue to decrease in semi-open canopy oak forest, as more competitive species (such as Pennsylvania sedge) would continue to increase.

Under Alternatives 2 and 3, treatment activities would occur to reduce woody vegetation and encourage the presence and abundance of savanna and KBB nectar plants. Alternatives 2 and 3 would promote an adaptive management approach to savanna restoration, with each potential treatment action having the results monitored prior to implementation of another treatment action. In some cases, one or two initial treatments could potentially be sufficient to meet objectives, without additional types of treatment being implemented.

Herbicide use may be used to reduce resprouting of cut woody vegetation. There would be some negative effects on savanna/nectar plants if any herbicide came into contact with adjacent, non-target vegetation. Efforts would be made to minimize this risk. There would also be the potential for spot and strip application of herbicide to also injure or kill adjacent or nearby non-target plants. Biologist/botanist identification of herbicide spray locations in the

savanna treatment units would minimize the effects of herbicides on savanna/nectar species whose presence is determined to be of importance to meeting the project objectives. There would also be potential effects associated with the use of triclopyr and imazapyr. Triclopyr can affect non-target plants due to some accumulation in the soil and the related plant uptake through the roots (Newton, et al. 1990). Imazapyr may cause damage to nearby non-target plants due to the release of imazapyr from the roots of treated target plants (Tu, et al. 2004).

Prescribed burning is a preferred method of treatment for savanna restoration, as it mimics natural wildfire conditions that were instrumental in maintaining pre-settlement savanna conditions. Prescribed burning, depending upon timing and fire intensity, would result in a reduction of woody plants, release nutrients for herbaceous plant growth, decrease the presence/abundance of non-fire adapted plant species, increase soil exposure to solar warming to favor warm season grass growth, and open up the ground layer for the seed germination of savanna species. Overall, there would be a positive response for nectar savanna plants, though vegetative monitoring would be essential to prevent unacceptable increases in the abundance of bracken fern or Pennsylvania sedge that may occur as a result of prescribed burning activities.

Soil scarification would occur following fire or due to mechanical scarification treatments. These would promote the establishment and growth of species present in the existing seedbank, and would favor opportunistic species. Negative effects would occur for savanna plant community composition when NNIS species are stimulated by scarification. However, many NNIS species are also nectar sources for KBB, so the negative aspect of invasiveness would be relative to the balance of plant species composition, long-term consequences for plant community composition due to invasive plant competition, and the role in providing nectar to insects. Positive effects would occur for native species which are stimulated by the soil exposure, such as lupine and Hill's thistle. Scarification by fire would benefit those species adapted to a fire-dependant ecosystem and would encourage an increase in more conservative savanna species such as June grass, lupine, birds-foot violet, and others.

Mechanical scarification would not supress non-fire adapted species or encourage savanna fire-dependant plants. It would result in a change in plant composition dependant upon successful herbicide application and the subsequent planting/seeding of native species. It would provide a positive benefit in situations where Pennsylvania sedge forms a monotypic mat that precludes the presence of most other plant species. Scarification to break up the root mass of the sedge, followed by herbicide application and subsequent planting of natives would help improve stand biodiversity and increase the presence/abundance of savanna/nectar species. Mechanical scarification in areas that already have a good nectar seedbank would potentially encourage invasive plants and may kill off seed sources of more conservative nectar or savanna species, or species that are not commercially available for re-planting, thus moving the stand away from target goals of a diverse herbaceous layer with a variety of nectar species.

The planting of plugs or seeding of native plants to serve as innoculum for the remainder of the stand would result in an increase in either the number of savanna or nectar species present or an increase in the abundance of species already present at lower densities. This would provide a positive effect of recruiting additional savanna/nectar species where the species is currently not present. An increase in abundance of species already present would primarily be of benefit for meeting wildlife objectives. To avoid a negative impact on existing nectar species in the

stand, plugs would need to be placed outside of areas which already have good nectar species presence.

Under Alternatives 2 and 3 southern Michigan genotype seed source plant material would be used to the extent market availability and funding allow. Studies suggest that genetic variability is such that, for some species, regional variations may affect successful food support for pollinators (Tallamy 2007). Greater plant genotypic biodiversity has been shown to support greater insect species richness (Crutsinger, et. al. 2006). Restoration using non-local seed could result in genotypes that persist for a long period of time (Gustafson, et al. 2005), affecting growth form, phenology and competition between local and non-local genotypes, and ultimately, pollinator insect support. Other recent studies are also highlighting the consequences of habitat fragmentation that results in genetic erosion and loss of genetic diversity that allows plant populations to maintain a mutation-drift balance and be able to better adapt to changing environmental conditions (Honnay and Jacquemyn 2006).

Increased open lands favoring herbaceous vegetation would likely result in an increase in deer browse. Herbivory has a noted effect on reduced nectar presence in the Project Area. The added density of cut woody stems from canopy opening treatment would also likely add to the presence of rabbit and small mammal habitat which would result in additional herbivory pressure on savanna nectar species unless brush/woody debris piles are removed from the Project Area or are chipped. Increased levels of deer grazing would reduce native plant richness while increasing the presence of exotic invasive plants (Seabloom, et. al. 2009). Herbivory effects on native plantings would be reduced in areas where protective fencing is used. Fencing areas would allow for the enhanced development of nectaring flowers and the dispersal of seeds into other portions of the savanna.

NNIS Treatments: Under Alternative 1, no mechanical or chemical treatment of NNIS would occur as a direct result of this project. The treatment of high-priority species would still be allowed as part of the HMNF Non-Native Invasive Program (NNIP). NNIP treatments would be focused primarily on those species that are not yet well-established on the Forest, are located in sensitive areas, or that provide an increased or unique threat. Under this alternative, NNIS would continue to expand in the areas where populations currently exist; especially those areas that are disturbed or adjacent to openings. This would further reduce habitat for native savanna and KBB nectar plant species.

Under Alternatives 2 and 3, autumn olive, leafy and cypress spurge, non-native bush honeysuckle, Japanese barberry, Scots pine, multiflora rose, Canada thistle, and garlic mustard would be treated with herbicide to reduce population levels in selected stands. Leafy and cypress spurges, Japanese barberry, multiflora rose and non-native bush honeysuckles would be treated in all areas where other treatment activities are proposed. The elimination of these species from these areas would provide an increase in the amount of habitat available for the establishment of native savanna/nectar species. Canada thistle would only be treated in stands designated for savanna restoration where thistle presence is a deterrent to successful restoration. Autumn olive would be treated in stands which are to be managed to maintain open conditions for savanna/nectar plant species. This treatment would promote the desired open conditions and would prevent soil chemistry changes (nitrogen fixation) associated with

autumn olive which can alter the habitat suitability of other native species that are adapted to open conditions.

Under Alternatives 2 and 3, additional NNIS treatment would occur in the areas being managed to promote nectar plant species and increasing KBB habitat. Herbaceous NNIS species that are considered a threat to KBB nectar plant establishment and persistence would be treated with herbicide. Additional treatments would also focus on areas where NNIS species are currently present along trails and roads, as these areas serve as sources of potential spread into the interior of adjacent stands. Focusing treatments in these areas would reduce the risk of NNIS spreading into new areas and negatively impacting present or established nectar plant species.

Allelopathic NNIS species (such as spotted knapweed) would be targeted where they are present in the interior of the stand. In most cases, it would be possible to limit the spray activities to a handheld sprayer or a wick application for single stem or small clump application. In areas of greater infestation, strip application of herbicides would occur. In these areas all plants within the strip would be killed, including some desirable savanna/nectar species. The negative effects of applying herbicides to desirable savanna/nectar species would be short-term for species that are able to be reseeded into the affected strips. Some savanna species are not easily re-established or are not commercially available. It is possible that there would be some negative effect of reducing the presence of some savanna species due to herbicide application, particularly in the areas receiving strip application. This effect would be mitigated by marking and excluding or providing protective covering to more conservative savanna/nectar species prior to herbicide application.

Transportation, Recreation, and ORV Damage: Under Alternative 1, no changes would occur to the current transportation system and the management of this system would be consistent with the Motor Vehicle Use-Map (2009). Roadways would continue to function as a vector for NNIS introduction and as a seed dispersal corridor.

The closing of roads under Alternatives 2 and 3 would reduce this vector. As a result, these alternatives would benefit savanna plant species since less native habitat would be lost to invasive plants. There would probably still be some NNIS movement along closed roadways for those plants already established along road corridors. Since the closed roads would not be obliterated, there would be no gain in habitat for sensitive species.

Throughout the Project Area (and especially in the White River Semiprimitive Nonmotorized Area (WRSNA), horseback riding is a popular recreational activity. Under Alternative 1, no changes would occur in horse-related recreational activities. Field surveys within the Project Area indicate that horse use is affecting plant habitat through: erosion of soils in sensitive areas, destruction of vegetative layers in areas frequented by horse camps, and the opening of the soil layer to NNIS establishment. Continued horse use in this area would promote the continuance of new introductions of additional weed, as horses have been documented as retaining seed from feed for 4–10 days and eliminating seed into new areas (Wells and Lauenroth 2007; Pickering and Mount 2010). Horse presence can also cause possible enhancement of growth of non-desirable plant species due to soil chemistry changes from manure loading (Westendorf 2009). Savanna nectar species are particularly noted for their ability to thrive or at least exist in nitrogen poor soils. A number of important savanna nectar species have a nitrogen fixing ability

within their root system that gives them a competitive advantage for existing in poor soils. As manure, or fertilizer is added to the soil, that competitive advantage would be lost to other species.

Under Alternative 2, horses would be confined to a designated trail within the WRSNA. As a result, the impacts of horses in this area would be much reduced (compared to dispersed horse riding in Alternative 1) as the impacts related to horses are generally the highest in previously untracked areas and lowest on constructed and maintained trails (Landsberg, et. al. 2001). Much of the proposed trail would occur in forested stands. While some impacts may occur from the introduction of weed species by horses or their riders, studies suggest that weed introduction in forested horse trail locations are limited (Campbell and Gibson 2001). Due to the concern regarding weed spread due to horses, however, periodic inspections would be made to determine if an increase in invasive species is developing along the designated trail route.

Under Alternative 2 horse camps would also be permitted in 11 designated locations within the Project Area. In these areas, manure would have to be removed by visitors when they leave the site. At these designated sites, anticipated effects would include an increase in the trampling of vegetation, added browse of herbaceous and some woody plants, added nitrogen loaded hotspots to the soil, and enhanced likelihood of introduction of invasive plants into the natural plant community. These 11 areas would represent a loss of potential habitat for savanna species. Again, similar to the designated trail, periodic inspections would enhance early detection of invasive plant introductions allowing for control before populations become well established to prevent designated camping areas from becoming NNIS sources.

Under Alternative 3, no horses would be allowed within the WRSNA. Currently used horse camp locations would be restored to natural vegetation conditions. The risk of horse trampling of savanna plants, compaction or erosion of soil, increased nitrogen loading and nitrogen hotspots, transfer of invasive plant materials and browse of natural vegetation would not occur in the White River area. While this activity would not be precluded in the Otto portion of the project area, horse-based recreation is an infrequent activity and would be expected to have negligible effects in this portion of the Project Area. This alternative would have the least impact of the three alternatives for herbaceous savanna species.

Off-road recreational vehicle use on the Forest is expected to occur on managed trails, however, illegal usage occurs on National Forest System lands and results in the destruction of plants and increases erosion damage to plant habitat. An example of such damage occurs in the northwestern portion of the WRSNA portion of the Project Area. In this area, there is a large blowout of sand which was created due to the loss of vegetation on sandy hills following ORV use. While restoration has been implemented by the Forest and the response has been good, there are still portions that remain unvegetated due to the difficulties associated with restoring vegetation in disturbed sand. The increase in the amount of open lands under Alternatives 2 and 3 would increase the area of land that would be attractive to this type of illegal usage. Increased enforcement would be necessary to improve early detection and remedial response to such activities occurring in the area.

In addition to horseback riding, there is seasonal recreational use throughout the Project Area associated with hunting, dispersed camping, and fishing. Some recreational users have caused

vegetation impact areas by parking or camping on thin, poor, sandy soils, where native vegetation is easily eliminated and NNIS can become easily established. While some of this impact occurs on the edges of forested stands, if the proposed forested areas in Alternatives 2 and 3 are converted to more open lands, there is a greater potential for this impact to occur in more areas. Barrier fences have been installed along various roads throughout the Project Area to prevent such effects. Implementing the closure of Forest Service roads would reduce vehicle access to existing or newly created open areas. The creation of 11 designated camping locations along County roads in Alternatives 2 and 3 would encourage focused areas of impact in contrast to scattered areas of impacts throughout the Project Area.

Effects on Non-Native Invasive Plant Species

Timber Harvesting: Under Alternative 1, no timber treatment would occur. Some new infestations of honeysuckle and autumn olive would most likely occur in openings within wooded stands or at stand edges due to seed dispersal by wildlife or other vectors. Lack of soil disturbances typically associated with timber harvesting activities would limit the opening of the soil to new infestations in the interior of the stands. Continued canopy closure would limit the growth and spread of shade-intolerant invasive species such as autumn olive. Leafy and cypress spurges would continue to spread in forested and non-forested stands as opportunities occur for dispersal from current population locations.

Under Alternatives 2 and 3, timber harvest activities would result in soil disturbances conducive to NNIS establishment and population expansion. Equipment cleaning under these two alternatives would reduce the spread of NNIS related to the proposed vegetative treatments.

Savanna Restoration: Under Alternative 1, no treatments would occur. NNIS species, such as autumn olive, cypress and leafy spurges, and honeysuckle, would increase in open areas, reducing the amount of habitat available for native herbaceous species. NNIS species would likely spread to additional locations within the Project Area.

Under Alternatives 2 and 3, varied treatments for savanna restoration would occur using an adaptive management approach. After each treatment action, analysis would be made of resulting conditions to determine if or what type of additional treatments would be needed to provide a sufficient amount of quality habitat for the KBB. These treatments would affect NNIS levels. Timber removal by would result in soil disturbance that would be conducive to NNIS germination. Handcutting would have minimal effect on the NNIS species.

All of the prescribed burning proposed in this project would be used to help reduce invasive plants and encourage the growth of native herbaceous species that are characteristic of healthy ecosystems. Many invasive plants begin growth early in the spring, prior to native plants. This would make prescribed burning during the spring season effective for reducing many invasive species. Fire is most effective over time, gradually increasing the numbers of species that naturally occur in ecosystems, while reducing non-native and native invasive species until a natural balance is achieved (Chicago Wilderness 2003). The precise timing of burning can reduce specific NNIS species. For example, burning in late April to mid-May can greatly reduce spotted knapweed seedling survival (MacDonald 2007). Prescribed burns would result in an

increase in NNIS species in situations where soil scarification occurs and weed seed sources are nearby. Prescribed burns would also result in an increase in some NNIS species such as autumn olive and leafy spurge due to a growth stimulation response to fire disturbance, unless cutting or burning of resprouts is done annually for up to 5 years. Plow lines constructed for fire control would result in soil exposure which would be conducive to NNIS germination. Immediate re-seeding of plow lines would help reduce this risk.

Seeding treatments would likely result in increases in NNIS presence in the disturbed soil in situations where weather conditions and/or timing of seed planting did not result in complete establishment of native plant species. This would be minimized, however, by limiting herbicide applications and seeding to appropriate weather and seasonal conditions, and by 3-5 years of subsequent weeding of new seedbeds.

NNIS Treatments: Under Alternative 1, no treatment would occur. NNIS species would continue to expand in population size, especially in areas adjacent to roadways and other areas of disturbance. New infestations of NNIS would likely occur. The diversity of native plants in the Project Area would decline as NNIS plants alter or replace native plants, and alter natural ecosystems (Westbrooks, 1998). Eventually, the population of an individual species would reach a level at which it would no longer be as feasible to eliminate it from the Project Area. Lack of prescribed fire would allow for the continued domination of more competitive species, as those species which are fire-dependant begin or continue to drop out of the habitat.

Under Alternatives 2 and 3, autumn olive, leafy and cypress spurges, non-native bush honeysuckle, Japanese barberry, garlic mustard, multiflora rose, and Canada thistle would be treated with herbicide to reduce population levels in selected stands. Leafy and cypress spurges would be treated in all treatment stands, in an effort to remove these species unless KBB monitoring indicates butterfly presence and herbicide is not approved for treatment. This would assist in restoring native plant habitat and minimizing the loss of native habitat due to invasive spurge population expansion. There would still be the possibility of the species proliferating in other portions of the Project Area that were not evaluated for treatment. There would also be a possibility of these species becoming reintroduced into the treatment stands at a future date due to nearby NNIS population sources. Autumn olive would be treated in stands which are to be managed for open conditions. This would prevent the soil chemistry changes (nitrogen fixation) which alters habitat conditions for native plant species. Japanese barberry, honeysuckle, multi-flora rose and garlic mustard are considered to be high-priority species for the Forest. Attempts would be made to mechanically or chemically eradicate these species where found. This would preserve future savanna habitat from invasive impacts. Canada thistle would be treated where determined to be causing a risk to the establishment or maintenance of savanna habitat.

Additional NNIS treatments would occur in stands being managed for nectar plant species to increase Karner blue butterfly habitat. Herbaceous NNIS considered a threat to the establishment or persistence of native nectar plants would receive herbicide application. Currently, infestations occur mainly along the existing roads and trails. Focusing treatment activities in these areas first, would limit the potential of these species spreading into the interior of surrounding stands.

Species that demonstrate allelopathic characteristics (i.e. spotted knapweed) would be targeted for population suppression in the interior of selected stands. While in most cases application would occur to single stems, there are a few locations that would warrant the strip application of herbicides. This would be followed by native seeding or planting. In areas of strip application, all of the plants within the strip would be killed. There would be a possibility of an increase in NNIS presence if the re-seeding of native plant species results in less than 100% cover during revegetation and/or if the seedbank contains viable NNIS seeds. This would be minimized by the weeding of all seedbeds for 2–5 years following seeding. Overall, the treatments for Alternatives 2 and 3 would result in a reduction of NNIS in Project Area openings.

Transportation, Recreation, ORV Damage: Under Alternative 1, no changes would occur to the current transportation system and the management of this system would be consistent with the Motor Vehicle Use Map (2009). Roadways would continue to function as a vector for NNIS introduction and as a seed dispersal corridor. The existing Forest Service road system would remain in place, and the threat of new introductions, and spread of existing NNIS would be sustained or increase with travel and visitor use. NNIS would likely germinate in soils exposed by ORV use. The consequence would be a reduction of habitat for native vegetation and those species that rely upon specific native plant species such as the Karner blue butterfly.

Under Alternatives 2 and 3, road closures would occur which would reduce the spread of NNIS through road maintenance activities such as plowing and grading, and would reduce the amount of vehicle disturbance that creates suitable conditions for the germination of NNIS. It would be expected that some spread of NNIS would still occur from populations already established along road corridors.

Under Alternative 2, horse use on National Forest System lands within the WRSNA would be limited to a designated trail, 11 camping sites, and two parking areas. There would be no limitations on this use on lands not under the jurisdiction of the Forest Service or in areas outside of the WRSNA. Under Alternative 3, no horse use would be permitted within the WRSNA portion of this Project Area. The effects of these actions on NNIS (as well as the effects on NNIS related to illegal ORV use) have already been discussed.

Effects on Threatened/Endangered/Regional Forester Sensitive Plant Species (TES)

Project analysis for TES plant species is found in the Biological Evaluation (Project Record). No federally threatened or endangered plant species are found in the Project Area. Three sensitive species (RFSS) were found in the areas proposed for treatment. These include: Alleghany plum, purple milkweed and Hill's thistle. The determination of the effects from this project on these species is summarized in Table 3.13.

Table 3.13: Determination Table by Habitat Type for Regional Forester Sensitive Plant Species

Habitat	Alternative 1	Alternative 2	Alternative 3
Oak Woodland	MINT[1]	MINT	MINT
Early Successional Forested (Aspen)	No Effect	MINT	MINT
Conifer Forested	No Effect	MINT	MINT
Dry-mesic Openings	MINT	MINT	MINT
Streambanks	MINT	MINT	Beneficial Effect

[1]*MINT = May Impact, Not Likely To Trend. This determination can refer to positive or negative impacts, noting simply that there will be effects to the species or habitat, but none that would likely cause a trend towards threatened or endangered species listing or a loss of viability.*

The determinations of project effects for sensitive species found in the areas proposed for treatment are summarized below in the Determination Table for Plant RFSS (Table 3.14).

Table 3.14: Determination Table for Regional Forester Sensitive Plants found in the Project Area

RFSS	Alternative 1	Alternative 2	Alternative 3
Alleghany Plum	MINT[1]	MINT	MINT
Hill's Thistle	MINT	Beneficial Effect	Beneficial Effect
Purple Milkweed	MINT	Beneficial Effect	Beneficial Effect

[1]*MINT = May Impact, Not Likely To Trend. This determination can refer to positive or negative impacts, noting simply that there will be effects to the species or habitat, but none that would likely cause a trend towards threatened or endangered species listing or a loss of viability.*

(3.4d) Cumulative Effects

Within the Project Area, there are three on-going vegetative treatment projects that were authorized through previous NEPA analysis. These are discussed above in the Woody Vegetation Section and include:

1. Approximately 50 acres in Greenwood Township that is being converted from red pine to an upland opening with treatments of timber harvest, prescribed burning, and seeding and planting to restore herbaceous savanna plant ecosystem;
2. Approximately 78 acres in Greenwood Township which have been converted from red pine and oak to upland openings to evaluate the effects of varying combinations of mechanical and prescribed burn treatments and to determine the best methods for returning pine and oak forest habitat to an herbaceous dominated savanna system; and
3. Approximately 346 acres in other upland opening sites within the Project Area where encroaching woody vegetaton will be removed to restore the areas to open conditions.

Within these treatment areas, woody vegetation will be reduced to an average of 5–20% canopy cover for overstory and 10–25% for understory saplings and shrubs. A suite of nectar producing herbaceous savanna species will be established by seeding or planting in areas where a natural flushing response of such species from the seedbank in the soil does not occur. Project activities are expected to occur over as long as a ten year period to re-establish a savanna condition. The effects of these projects will be a renewal of the savanna conditions that favor populations of the savanna nectar and RFSS species. The positive effects on these species would be additive to the

ones generated from the current proposed project under Alternatives 2 and 3. Should Alternative 1 be selected for this proposed project, then the above treatments would allow for a limited remnant of savanna habitat to be maintained, enhanced, or slightly expanded.

Outside of the above-noted treatments, oak savannas would continue the state-wide trend of loss due to encroachment by and succession of woody vegetation, and invasive plant savanna habitat quality deterioration (MNFI 2009). Lack of fire, and other management tools to renew savanna habitat would result in a continuing trend of loss of habitat for RFSS savanna species, both on the Forest and within the historical savanna habitats of the southern to mid-lower Michigan peninsula.

Efforts are being made to restore savanna in other portions of the State as well. The Forest has initiated savanna restoration in the M37 Project Area and in portions of the Mast Lake Project Area, both in Newaygo County. The Forest also undertook an experimental restoration of pine plantation to dry sand prairie habitat in the Newaygo Experimental Forest. That project has not continued to completion at this point in time, as encroachment of red pine and other factors are contributing to delay in successfully attaining a restoration in the area. Some restoration on non-Forest lands is also occuring through support from The Nature Conservancy.

An increase in development on private lands is expected in the future. Such population growth would likely increase the number of residences within the cumulative impact area. This would decrease the amount of undeveloped plant habitat and increase the likely introduction of NNIS. Increased land development on private lands would create additional problems for rare plants by creating more isolated populations and reducing genetic exchange needed for healthy populations.

Herbivory is known to effect savanna or prairie herbaceous species. Small mammals have been shown to negatively affect forb species (Martinez-Garza, et. al. 2003) through grazing, and through seed predation (Bricker, et. al. 2010). Deer browse is also a major factor (Anderson, et. al. 2007) affecting forb species. Management to create more savanna is likely to increase effects of herbivory on savanna and sensitive plants in the Project Area and in nearby private lands.

Major highway corridors close to the Project Area will continue to bring visitors and vehicles into this area and promote the spread of NNIS. The Forest Service will continue to monitor and treat National Forest System lands adjacent to the Project Area to inhibit the spread of those NNIS of concern; however, because of the recreational use, new invasive species introductions are likely. Residential road construction, development, and equestrian use will create additional vectors for NNIS plants' dispersal along the network of county primary, secondary, and Forest Service roads.

Recreation and associated vehicle use will provide the disturbance necessary for the proliferation of the NNIS plants by generating soil disturbance and providing for the dispersal of seeds. The seeds and plant material are transported as vehicles move from one area to another, within and outside the Project Area. Forest and County roads open to motor vehicle use will provide locations for invasive plant species populations to increase, expand, and move into areas not currently infested.

All NNIS plants identified in the surveys of the Project Area are likely to spread and occupy more of the land base in the future, although at differing rates of spread. The Forest Service is forming partnerships with other agencies and landowners whose property serves as a source of non-native invasive plant species (Michigan Stewardship Network). Cooperative efforts can increase the likelihood of effective NNIS management by addressing both public and private land holdings with NNIS species present. In addition, the Forest has a wide-scale, limited-use pesticide Environmental Assessment to control and eradicate high-priority NNIS plants for up to 2,000 acres per year across the Forest.

Private landowners may use mechanical and chemical means to reduce the presence of weeds on privately held properties. No data currently exists to estimate how effective these treatments are in the analysis area. Agricultural landowners in the area are likely to use pesticides in their farming practices. Concern has been expressed during scoping that the Proposed Project might impact area agricultural practices of pesticide treatment and negative effects to Karner blue butterfly. No private agricultural lands are expected to occur in close enough proximity to the Project Area for an effect of private lands pesticide application on proposed expanded Karner savanna habitat.

Oak savannas have been decreasing in both quanitity and quality in the southern to mid-part of lower Michigan, largely due to lack of fire. Oak savanna areas would continue to be encroached upon by woody vegetation on both private and public lands, making them increasingly unsuitable for savanna nectar and RFSS plants. Lack of fire, and other management tools to renew savanna habitat would result in a continuing trend of loss of habitat for these species, both on the Forest and within the historical savanna habitats of the southern lower Michigan peninsula. Creation/restoration of the savanna and dry openings habitat in this proposed project would create a beneficial overall effect of increasing habitat for oak savanna nectar and RFSS plant species.

Conclusion: Alternatives 2 and 3 would result in an increase in favorable conditions for savanna and open habitat RFSS plant/nectar species, and would reduce NNIS populations and spread. Alternative 3 would result in removal of impacts from horse-related recreational activities, resulting in greater protection of restored savanna habitat. Alternative 1 would continue to contribute to the disappearance of adequate quality habitat for savanna and open habitat plant species, and would not lessen the negative effects of NNIS on native/sensitive/nectar plant habitat.

(3.5) Wildlife

(3.5a) Existing Condition and Resource-Specific Information

Wildlife Species Habitat Associations

Early-Successional Vegetative Types

Openings, prairies, savannas, and barrens have declined within the Huron-Manistee National Forests (HMNF) over the past century due to extensive reforestation, increased fire control efforts, and the processes of natural succession. Remnant openings, prairies, savannas, and barrens are filling in with fire intolerant woody and shade tolerant herbaceous species. As a result, suitable habitat for the Karner blue butterfly (KBB), a federally-listed Endangered species and Terrestrial Management Indicator Species associated with oak/pine savanna and pine barren communities, is becoming scarcer. The decline in KBB habitat quality and quantity within the HMNF has led to a reduction in occupied subpopulations.

Early successional forest types (such as aspen) are also gradually being lost due to succession. Forest maturation of aspen forest communities may be reducing habitat quantity and quality for ruffed grouse, a Terrestrial Management Indicator Species associated with early successional forests dominated by aspens and poplars (*Populus* spp.). The Forests' monitoring information for grouse indicates that the population is stable with oscillations in year to year estimates likely resulting from the well known "ten-year cycle" in ruffed grouse numbers (HMNF 2008). Population trends for the State of Michigan indicate that the most recent low in grouse abundance occurred during 2004-2005, the most recent high in grouse abundance occurred between 1998 and 2000, and the next grouse population peak might occur between 2010 or 2011 (Frawley and Stewart 2009).

Other game and non-game wildlife species that may be associated with early successional vegetative types within the Project Area include, but are not limited to: eastern box turtle, hill-prairie spittlebug, dusted skipper, frosted elfin, red-headed woodpecker, whip-poor-will, American woodcock, cottontail rabbit, snowshoe hare, fox and gray squirrel, red and gray fox, coyote, wild turkey, and white-tailed deer. Early successional wildlife species are declining across their range in Michigan due to habitat loss and degradation and direct mortality resulting from fire suppression, vegetative succession, vegetative management, transportation management, water level manipulation, wildfires, human persecution and illegal collection, and vehicle collisions (USDA Forest Service 2005).

The Forest Plan emphasizes management for oak barrens/savanna ecosystems, particularly for KBB conservation, and directs the restoration and maintenance of 20,300 acres of savanna/barrens within designated KBB population management areas and essential KBB habitat within the HMNF (USDA Forest Service 2006b). The Forest Plan also recognizes the importance of early successional aspen communities, identifying a goal of approximately 2,400 acres of aspen regeneration harvests annually to create early successional habitat for a variety of species (USDA Forest Service 2006b). Currently, none of the approximately 859 acres of aspen stands or 1,056 acres of aspen/oak stands within the Project Area are in an early successional stage (<10 years of age). Over the next decade, the Forest Plan calls for 16% (24,100 out of

149,909 acres) of aspen stands within the HMNF to be in an early successional stage (USDA Forest Service 2006b).

Mid- to Late-Successional Forest Types

Mid- to late-successional forest types within the HMNF provide habitat for a variety of wildlife species including the Indiana bat, a federally-listed Endangered species known to hibernate in small numbers at Tippy Dam, which is within the administrative boundary of the Manistee National Forest on the Manistee River (USDA Forest Service 2006a). Except for records in the Tippy Dam area, no occurrences are documented for Indiana bat on the HMNF (USDA Forest Service 2006a). Major threats to Indiana bats in Michigan are disturbance to hibernating bats and destruction/degradation of non-hibernating bat habitat (USDA Forest Service 2006a).

Other game and non-game wildlife species that may be associated with mid- to late-successional forest types within the Project Area include, but are not limited to: northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, eastern box turtle, pileated woodpecker, brilliant scarlet tanager, black bear, red and gray fox, coyote, black-throated green warbler, gray and fox squirrel, white-tailed deer, bobcat, and northern flying squirrel. Acreage of mid- to late-successional forest types has increased within the HMNF. However, forest fragmentation and disturbance/destruction of nesting, roosting, and foraging sites resulting from timber harvest and road construction threatens the viability of these species (USDA Forest Service 2005, USDA Forest Service 2006a). Management for early successional vegetative types under the Forest Plan would involve the conversion of mature forest stands. Currently, mid- to late-successional forests within the Project Area include approximately 4,469 acres of black oak, 2,737 acres of mixed oak, 1,915 acres of aspen and aspen/oak, 1,331 acres of lowland hardwoods, 1,282 acres of red pine/oak and white pine/oak, 1,092 acres of red pine, 428 acres of jack pine/oak, 356 aces of white pine/hemlock, 161 acres of lowland conifer, and 87 acres of jack pine/scots pine.

Streams, Creeks, Lakes, and Wetlands

In addition to the aforementioned vegetative types, there are several rivers, streams, creeks, lakes, and wetlands (i.e., White River, North Branch of the White River, South Branch of the White River, Mud Creek, Carlton Creek, Sand Creek, Knutson Creek, Bear Creek, Newman Creek, Rockdale Pond, Knapp Lake) within the Project Area. These waters and their associated uplands may provide habitat for waterfowl and shorebirds, such as great blue heron, wood duck, mallard, black duck, Canada goose, and other water-oriented species such as beaver, Blanding's turtle, and wood turtle. In Michigan, the viability of these species is being threatened by habitat loss and degradation, disturbance of foraging and nesting animals, and increased mortality resulting from human activities such as draining wetlands for agriculture, development adjacent to water bodies and along shorelines, road construction, increases in recreational use and traffic, pollution, and illegal collection (USDA Forest Service 2005).

Occurrence of Sensitive Wildlife Species

The Huron-Manistee National Forests provide habitat for 382 species of breeding vertebrate animals. These include 168 species of birds, 54 species of mammals, 24 species of reptiles, 18 species of amphibians, and 118 species of fish. The Forests also provide habitat for 28 migratory species and a large number of invertebrates, primarily insects.

Federally-listed Threatened and Endangered (T&E) species, Terrestrial Management Indicator Species (MIS), and Regional Forester's Sensitive Species (RFSS) that may be present or have habitat within the Project Area include: Karner blue butterfly, Indiana bat, dusted skipper, frosted elfin, hill-prairie spittlebug, red-headed woodpecker, whip-poor-will, ruffed grouse, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, northern goshawk, red-shouldered hawk, eastern box turtle, wood turtle, and Blanding's turtle. The habitat ecology and distribution (within Michigan, and if available, within the MNF) of these species are briefly summarized in Table 3.15. Citations are noted where more detailed information can be found concerning ecology, life history, and status. Trends for Terrestrial Management Indicator Species on the HMNF are discussed in the Monitoring and Evaluation Report for Fiscal Year 2008 (HMNF 2008).

A Biological Assessment and Biological Evaluation (see Project File) determined the potential effects of proposed actions on all of the wildlife species listed in Table 3.15. Ruffed grouse is not considered because it is a Terrestrial Management Indicator Species, not a federally-listed Endangered or Threatened Species or RFSS. To determine which species to include in the Biological Assessment and Biological Evaluation, the following process was used:

- We determined all federally-listed (and those proposed to be listed) Endangered and Threatened species that occur or have historically occurred in Michigan, based on U.S. Fish and Wildlife Service and Michigan Natural Features Inventory (USDI Fish and Wildlife Service 2006, MNFI 2010) records.
- We determined RFSS that can potentially occur on the Baldwin/White Cloud Ranger District of the HMNF.
- From these determinations, we selected species that have occurrence records on the MNF and/or have the potential to occur on or near the project site based on habitats present, species habitat requirements and historical occurrences. The Michigan Natural Features Inventory database (MNFI 2010), Huron-Manistee National Forests Endangered, Threatened and Sensitive species database (USDA Forest Service 2007a), and Forest Service Fauna database (USDA Forest Service 2007b) are three important occurrence record sources. Other sources include the annual surveys conducted for Karner blue butterfly, and bat echolocation surveys.
- We further refined the list by evaluating field survey data collected specifically for this project.

All other RFSS were not included because: 1) they have not been documented to occur on the MNF; 2) they are found in habitat(s) unlike those found in the Project Area; 3) they were not found during field surveys; and/or 4) habitat for the species exists within the Project Area; however, the species would not be present within the Project Area during project implementation. RFSS not included in this evaluation will have no effect from the Proposed Action.

Table 3.15: Habitat Ecology and Distribution for Wildlife Species included in this Environmental Assessment

Common Name	Species Name	Habitat Ecology	Distribution
Karner Blue Butterfly	*Lycaeides melissa samuelis (Nabokov) [or Plebejus melissa (Edwards 1873)]*	Heterogeneous oak/pine savanna/barrens habitats with variable light conditions, abundant wild lupine (the sole food source for the caterpillar), abundant adult nectar sources, warm season grasses for basking and roosting, and ants to protect larvae from parasites and predators. Dispersal between subpopulations needs to be maintained by connecting subpopulations with corridors and maintaining an average nearest neighbor distance of 1 km between subpopulations (Rabe 2001, USDI Fish and Wildlife Service 2003).	Found in 11 counties in Michigan. Small, isolated populations occur in Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo, and Oceana counties in the MNF (Rabe 2001, USDI Fish and Wildlife Service 2003).
Indiana Bat	*Myotis sodalist*	Roost and form maternity colonies under loose, exfoliating bark of usually dead trees, in live shag-bark trees, or in hollows and cavities of mature trees in floodplain and bottomland forests, riparian zones, wooded wetlands, and upland forests. Roost trees are typically within canopy gaps that provide solar exposure. Eat terrestrial and aquatic insects while foraging in forested stream corridors, upland bottomland forests, and over impounded bodies of water at night (MNFI 2010, USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006, USDI Fish and Wildlife Service 2007).	Summer (May 15 to August 15) distribution includes 16 counties in southern Michigan. Small number hibernates at Tippy Dam within the MNF on the Manistee River in Manistee County (MNFI 2010, USDA Forest Service 2006a).
Ruffed Grouse	*Bonasa umbellus*	Mixed deciduous and conifer forests (especially early seral stages dominated by aspen) and oak-savanna woodland. Forests 5-25 years old provide brood habitat and cover. Older forest age classes provide nesting habitat and winter food sources. Eats herbaceous plants, seeds, fruits, insects, and buds and leaves of trees/shrubs (NatureServe 2010).	Broadly distributed throughout Michigan and the MNF (NatureServe 2010).
Dusted Skipper	*Atrytonopsis hianna*	Typically found in localized colonies in bluestem grassland, barrens, prairie, or other openland habitats where little bluestem - its larval food plant - occurs [larvae may also feed on big blue stem (*Andropogon gerardii*)]. Adults nectar on a variety of plant species, including blackberry, cinquefoil, lupine, puccoons, vetches and yarrow (USDA Forest Service 2005).	Found in localized, patchy colonies scattered across 15 counties of the Lower Peninsula, from Cheboygan to Monroe counties. Occurs in Oceana, Muskegon, Mecosta, Newaygo, and Lake counties in the Manistee National Forest (USDA Forest Service 2005, NatureServe 2010).
Hill-Prairie Spittlebug	*Lepyronia gibbosa*	Prairie bowls in mesic dry sand prairie zones. Feeds on many families of forbs (NatureServe 2010).	Located typically in highly restricted disjunct populations (often in only a half-meter-wide mesic zone around prairie bowls) within 6 counties in southwest Michigan. Occurs in Oceana, Muskegon, Montcalm, Newaygo, and Lake counties in the Manistee National Forest (NatureServe 2010).

Common Name	Species Name	Habitat Ecology	Distribution
Frosted Elfin	*Incisalia irus*	Grassy openings or burn scars in barrens and savannas with abundant wild lupine, false indigo, or wild indigo – its host plants - and other nectar sources (NatureServe 2010).	Located in scattered isolated populations in 11 counties in Michigan. Occurs in Oceana, Muskegon, Mecosta, Montcalm, Newaygo, and Lake counties in the Manistee National Forest (NatureServe 2010).
Eastern Box Turtle	*Terrapene carolina carolina*	Forested habitats (coniferous, deciduous and mixed) with sandy soils near a source of water. Also found in thickets, old fields, pastures, marshes, vegetated dunes, and at bog edges adjacent to water sources. Access to sandy, open areas for nesting sites is critical for successful reproduction. Eats plants, fruit, fungi, snails and other invertebrates, carrion, and rarely small vertebrates (Hyde 1999, USDA Forest Service 2005, NatureServe 2010).	Within the past 10 years, found in 20 counties in Michigan. Occurs in fragmentated populations in Mason, Manistee, Oceana, Muskegon, Newaygo, and Lake counties in the Manistee National Forest (Hyde 1999, USDA Forest Service 2005, NatureServe 2010).
Red-Headed Woodpecker	*Melanerpes erythrocephalus*	Open woodlands, especially with beech or oak, open situations with scattered trees, parks, cultivated areas, and gardens with mast crop abundance. Nests in excavated holes in live trees, dead stubs, snags, utility poles, or fence posts. Eats insects, invertebrates, berries and nuts, sap, and young and eggs of birds (USDA Forest Service 2005, NatureServe 2010).	Species is widespread across the Huron-Manistee National Forest, but is uncommon, and populations occur in smaller more isolated habitat patches (USDA Forest Service 2005, NatureServe 2010).
Whip-Poor-Will	*Caprimulgus vociferous*	Insectivore that occurs in open coniferous, deciduous, and mixed woodlands with well spaced trees and a low canopy, abundant shade, nearby open areas, and sparse ground cover. Prefers stands of even-aged young to medium aged second-growth, including early successional aspen/birch (USDA Forest Service 2005, NatureServe 2010).	Broadly distributed throughout Michigan and the Manistee National Forest, occurring in all the counties located in the Forest, and in all but 10 counties in the central, southern, and southeastern parts of Michigan (USDA Forest Service 2005, NatureServe 2010).
Bald Eagle	*Haliaeetus leucocephalus*	Nests in tall, dominant deciduous or coniferous trees, and sometimes cliffs, along or close to (within 4 km) major rivers, large lakes, deep marshes, or clusters of small lakes and streams where adequate prey is available and human disturbance is minimal to none. Preys primarily on fish, but frequently feeds on carrion, waterfowl, and other birds and mammals (NatureServe 2010, USDA Forest Service 2006a, USDI Fish and Wildlife Service 1983, USDI Fish and Wildlife Service 2006).	Breeding records are documented within 46 counties in the Lower Peninsula. Occurs within all counties within the Manistee National Forest. The number of active territories on or near the HMNF exceeds 45, producing more than 50 fledglings per year (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006, NatureServe 2010).

Common Name	Species Name	Habitat Ecology	Distribution
Cerulean Warbler	*Dendroica cerulea*	Insectivore that nests and perches in the canopy of large, tall, trees that occur in large tracts (≥ 3,000 hectares) of mature deciduous forest within one kilometer of rivers and the Lake Michigan shoreline. Prefer bottomlands, particularly floodplains and lowland hardwoods, over uplands. Most commonly found in forests with an open understory dominated by maple, ash, sycamore, beech, oak, black walnut, and black locust (USDA Forest Service 2005, Hyde et al. 2000, NatureServe 2010).	Documented occurrences are recorded within 16 Michigan counties. Habitat is broadly distributed across the Manistee National Forest and occurrences are documented within the Forest in Mason, Montcalm, Muskegon, and Oceana Counties, including in the Nordhouse Dunes Wilderness Area, and along the Manistee and White Rivers (USDA Forest Service 2005, Hyde et al. 2000, NatureServe 2010).
Louisiana Waterthrush	*Seiurus motacilla*	A riparian obligate species that nests along clear, fast-flowing streams and rivers in contiguous, deciduous, and often hilly forests containing moderate to sparse undergrowth. Nests on the ground along stream banks, hidden in the underbrush or among the roots of fallen, upturned trees, in crevices or raised sites in tree roots, or in rock walls of ravines over water. Preys primarily on aquatic insects, and also small mollusks, killifishes, minnows, and salamanders (Gibson 2007a, NatureServe 2010).	Documented occurrences are recorded within 12 Michigan counties, including Montcalm, Muskegon, and Oceana Counties within the Manistee National Forest (Gibson 2007a, NatureServe 2010).
Northern Goshawk	*Accipiter gentilis*	Nests in large tracts of mature pine, hardwood, or mixed forests with an intermediate amount of canopy closure, large deciduous trees for nesting, small forest openings for foraging, and an open understory. Preys on a wide variety of vertebrates and, occasionally, insects. (Cooper 1999a, USDA Forest Service 2005, NatureServe 2010).	Breeding records are documented within 24 counties in the Lower Peninsula. More than half of the total occurrences in Michigan are recorded from the Huron-Manistee National Forests. Generally widely distributed and abundant within the Manistee National Forest, occurring within all counties within the Forest, except for Mecosta County (Cooper 1999a, USDA Forest Service 2005, NatureServe 2010).
Prothonotary Warbler	*Protonotaria citrea*	Nests in tree cavities of dead snags and live trees within riparian corridors, wooded swamps, floodplain forests, and bottomland hardwood forests with dense underbrush near or over water along streams (often 20-40 meters wide), swamps, lakes, or ponds. Nest cavities usually are located somewhat low to the ground. Will nest in nest-boxes. Preys primarily on insects and spiders (Gibson 2007b, NatureServe 2010).	Documented occurrences are recorded within 16 counties in the Lower Peninsula, including Muskegon and Oceana Counties within the Manistee National Forest (Gibson 2007b, NatureServe 2010).

Common Name	Species Name	Habitat Ecology	Distribution
Red-Shouldered Hawk	*Buteo lineatus*	Nests in large tracts of mature deciduous or mixed forests with closed canopies, large deciduous trees for nesting, nearby wetland and upland habitats interspersed for foraging, and variable amounts of understory vegetation. Preys on a wide variety of vertebrates and, occasionally, insects (Cooper 1999b, USDA Forest Service 2005, NatureServe 2010).	Breeding records are documented within 36 counties in the Lower Peninsula. Except for Muskegon and Mecosta counties, occurs within all counties within the Manistee National Forest. High concentrations of nesting red-shouldered hawks with good reproductive success have been documented in the Manistee County area of the Forest (Cooper 1999b, USDA Forest Service 2005, NatureServe 2010).
Blanding's turtle	*Emydoidea blandingii*	Occupies productive, clean, shallow waters (lake shallows, ponds, marshes, creeks) with abundant aquatic vegetation and soft organic substrate. In spring and summer, during mating and nesting seasons, occupies terrestrial habitats, preferring to nest in adjacent open, sunny, upland areas with moist but well-drained sandy or loamy soils. Hibernates underwater within organic substrate of ponds and creeks. Omnivorous, feeding primarily underwater predominantly on crayfish and aquatic insects (Lee 1999b, USDA Forest Service 2002b, USDA Forest Service 2005, NatureServe 2010).	Documented within 36 counties in Michigan's Lower Peninsula and within all the counties in the Manistee National Forest. Fairly common in parts of the Lower Peninsula (Lee 1999b, USDA Forest Service 2002b, USDA Forest Service 2005, NatureServe 2010).
Wood Turtle	*Glyptemys insculpta*	Occupies clear, medium-sized rivers with sand or sand-gravel substrates, and adjacent forested riparian and floodplain areas with numerous openings and a dense mixture of low herbs and shrubs, providing partially shaded, wet-mesic herbaceous vegetation such as raspberries, strawberries, grasses, willows, and alders along or near the river for foraging. In summer, occupies nearby terrestrial habitats, preferring to nest on steep, eroding, sandy, or sandy-gravelly slopes near the river that have little or no ground vegetation, are sunlit most of the day, and receive little human disturbance. Hibernates underwater under overhanging roots or logs, in pools or along the stream bottom under the ice, or in beaver lodges or muskrat burrows (Lee 1999a, USDA Forest Service 2004b, USDA Forest Service 2005, NatureServe 2010).	Documented within 45 Michigan counties and within all the counties in the Manistee National Forest. Within the Manistee National Forest, has been found on the Pine, Little Manistee, Big Sable, Pere Marquette, Baldwin, White, and Muskegon Rivers and their tributaries. Suitable habitat is widely distributed and of high abundance across the Manistee National Forest (Lee 1999a, USDA Forest Service 2004b, USDA Forest Service 2005, NatureServe 2010).

The Endangered Species Act of 1973 requires federal agencies to ensure that actions authorized, funded, or carried out by the agency are not likely to jeopardize the continued existence of federally-listed or proposed-to-be-listed Endangered or Threatened species or to adversely modify critical habitat. Five federally-listed species were considered for the Project Area: Indiana bat (potential habitat), piping plover, Kirtland's warbler, Karner blue butterfly, and Pitcher's thistle. The Project Area is outside the potential range for piping plover, Kirtland's

warbler, and Pitcher's thistle on the HMNF. As such, these species will not be analyzed further. Piping plover, Kirtland's warbler, and Pitcher's thistle have recently been addressed in a programmatic Biological Assessment (USDA Forest Service 2006a) and subsequent Biological Opinion (USDI Fish and Wildlife Service 2006). The Indiana bat and Karner blue butterfly could occur in the Project Area and were analyzed to determine the potential effects from implementation.

No proposed treatments are within the Tippy Management Zone (swarming habitat) for Indiana bat (*Myotis sodalist*) (Biological Opinion (BO) dated June 12, 2003). However, the Project Area is within the potential breeding range for Indiana bat. Breeding Indiana bats are unlikely to occur within the Project Area as no suitable breeding habitat was found during wildlife surveys conducted in 2006, 2007, and 2009, and no vocalizations of Indiana bat were recorded during bat echolocation surveys conducted in summer 2009, which can be used to distinguish this species in the field (personnel communication, Eric Britzke, U.S. Army Corps of Engineers, April 1, 2010). However, based on a review of GIS vegetative data layers and tree record data, potential breeding habitat for Indiana bat might occur within 5 stands proposed for treatment in the Project Area. These include: U.S. Forest Service Compartment 458 Stand 6, Compartment 438 Stand 22, Compartment 438 Stand 25, Compartment 418 Stand 130, and Compartment 416 Stand 32.

Sites that have had a documented occurrence of Karner blue butterfly within the past three years are considered to be "occupied" (personnel communication, Jessica Hogrefe, USDI Fish and Wildlife Service, February 21, 2007). There are currently 73 openings covering 519 acres that are considered to be occupied by the KBB within the Project Area. Based on the overlap of historical occurrences of savanna/barrens habitats and KBB, 2,542 acres within the Project Area have the potential to be restored to suitable KBB habitat. *No designated critical habitat* exists for federally-listed Endangered or Threatened species in any of the treatment areas.

The following RFSS have documented occurrences within the Project Area: dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, red-headed woodpecker, whip-poor-will, bald eagle, cerulean warbler, northern goshawk, Louisiana waterthrush, prothonotary warbler, Blanding's turtle and wood turtle (Tables 3.16, 3.17, and 3.18).

Table 3.16: Michigan Natural Features Inventory Results for Regional Forester's Sensitive Wildlife Species within the Savanna Ecosystem Restoration Project Area

RFSS Wildlife Species	Township, Range	Section(s)
Bald Eagle	T12N, R16W	4
Blanding's turtle	T13N, R15W	9
	T13N, R16W	10
Cerulean Warbler	T12N, R16W	4, 5
	T13N, R15W	9, 20, 29, 30
	T13N, R16W	25, 33, 34, 35, 36
Dusted Skipper	T12N, R16W	5
	T13N, R16W	32
Eastern Box Turtle	T12N, R16W	4, 5, 6, 7
	T12N, R17W	1, 12
	T13N, R15W	19
	T13N, R16W	2, 11, 23, 25, 26, 27, 29, 32, 34, 35

RFSS Wildlife Species	Township, Range	Section(s)
Frosted Elfin	T13N, R15W	15, 16, 17, 19
	T13N, R16W	27, 34
Hill-Prairie Spittlebug	T12N, R16W	5
	T13N, R15W	17
	T13N, R16W	27, 28, 29, 32, 33
Louisiana Waterthrush	T12N, R16W	4
	T13N, R16W	25, 34, 35
Northern Goshawk	T13N, R16W	4, 5
Prothonotary Warbler	T12N, R16W	4
	T13N, R15W	30
Wood Turtle	T12N, R16W	4, 5, 6, 7
	T12N, R17W	1, 12
	T13N, R15W	9, 10, 16
	T13N, R16W	1, 2, 3, 4, 9, 10, 11, 12, 14, 15, 31, 32, 33
	T13N, R17W	36

Table 3.17: Huron-Manistee National Forests Endangered, Threatened and Sensitive Species Database Results for Wildlife within the Savanna Ecosystem Restoration Project Area

RFSS Wildlife Species	Township, Range	Section(s)	Compartment	Stand(s)
Blanding's Turtle	T13N, R16W	10	421	Not Specified
Eastern Box Turtle	T13N, R15W	19	439	21, 24, 25, 37
	T13N, R15W	20	439	16
	T13N, R16W	25	438	22, 25, 43, 62, 63
	T13N, R16W	27	418	22
	T13N, R16W	32	414	36, 50
	T13N, R16W	34	418	65
Hill-Prairie Spittlebug	T13N, R15W	17	439	4, 10, 42
	T13N, R15W	19	439	Not Specified
	T13N, R15W	30	439	25, 26, 27
Northern Goshawk	T13N, R15W	30	439	25, 27
Wood Turtle	T12N, R16W	5	416	1, 2
	T12N, R16W	5	407	1
	T13N, R15W	2	457	33
	T13N, R15W	7	437	Not Specified
	T13N, R15W	9	440	66
	T13N, R16W	2	Not Specified	Not Specified
	T13N, R16W	3	421	2

Table 3.18: U.S. Forest Service Survey Results for Wildlife within the Savanna Ecosystem Restoration Project Area

RFSS Wildlife Species	Township, Range	Section	Compartment	Stand(s)
Blanding's Turtle	T13N, R16W	1	Private Land in Compartment 423	230 meters North of Compartment 422 Stands 2, 17, 18
Dusted Skipper	T13N, R16W	26	418	29, 32, 90, 120, 129
Eastern Box Turtle	T13N, R15W	30	439	25
	T13N, R15W	20	437	22
	T13N, R15W	17	439	4, 6, 9
	T13N, R16W	11	422	3
	T13N, R16W	25	438	63
	T13N, R16W	26	418	28

RFSS Wildlife Species	Township, Range	Section	Compartment	Stand(s)
	T13N, R16W	27	418	68
	T13N, R16W	31	414	6
	T13N, R16W	32	414	59
	T13N, R16W	32	416	8
	T13N, R16W	34	418	7, 65, 67, 96
Hill-Prairie Spittlebug	T13N, R17W	36	414	16
Northern Goshawk (active nest and individuals seen)	T13N, R16W	11	422	3, 8
Northern Goshawk (individual seen)	T13N, R16W	23	418	89
Red-Headed Woodpecker	T13N, R16W	26	418	116
	T13N, R16W	27	418	22
Whip-poor-will (active nest)	T13N, R15W	17	439	4, 11
Whip-poor-will (active nest)	T13N, R15W	17	458	7
Whip-poor-will (individual seen)	T13N, R16W	25	438	43
Wood Turtle	T13N, R16W	34	418	107
	T13N, R17W	36	414	16

RFSS associated with mid- to late-successional forest types that could occur within the Project Area include bald eagle, cerulean warbler, northern goshawk, red-shouldered hawk, Louisiana waterthrush, prothonotary warbler, and eastern box turtle. No proposed treatment units are within close proximity (within ½ mile) to any known bald eagle nests or roosts, and the Project Area is located outside essential bald eagle habitat on the HMNF (USDA Forest Service 2006c). The closest known active bald eagle nest is documented within the oak/pine forests around Big Blue Lake, which is a little over a mile from proposed treatment units. However, potential foraging habitat for bald eagles may occur within the Project Area. Cerulean warbler have been documented to occur within the floodplain forest along the South Branch of the White River and the floodplain forest along the White River and the edge of Big Blue Lake. Active northern goshawk nests have been documented within the boundaries of the Project Area. In addition, in 2008, northern goshawks were observed stooping and calling at three other locations within the Project Area. Primary (660 feet) and secondary (960 feet) buffers around these active nests, as directed by The Management Recommendations for the Northern Goshawk on the Huron-Manistee National Forests (USDA Forest Service 1993), would incorporate a number of proposed treatment units. Although there are no documented occurrences of red-shouldered hawk within the Project Area, potential nesting habitat does occur within the available mid- to late-successional forest types. Louisiana waterthrush have been observed nesting in shrubs along the White River at Diamond Point and prothonotary warblers have been documented in the floodplain forest along Cleveland Creek and along the South Branch of the White River.

Blanding's turtle and wood turtle are RFSS that could be associated with lakes, rivers, and creeks within the Project Area. Blanding's turtle and wood turtle are documented to occur in several rivers and creeks that are within dispersal distance (0.5 miles) of the proposed treatment units. Blanding's turtle is documented to occur in the South Branch of White River, in Bear Creek/Newman Creek, and crossing 136th Street near Bear Creek. In addition, during field

surveys in 2009, a Blanding's turtle was found crossing Arthur Road near Knutson Creek. Wood turtle have been documented to occur in Rockdale Pond, the White River, the North Branch of the White River near Arthur road, the South Branch of the White River and crossing a road near Knutson Creek. In addition, in 2008, a wood turtle was observed near Mud Creek, with an additional observation occurring in 2009.

(3.5b) Area of Analysis

Under the National Environmental Policy Act (NEPA), cumulative effects are defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Under Section 7 of the Endangered Species Act (ESA), cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the Action Area considered in the BA/BE. The area of analysis for the direct and indirect effects on wildlife resources is the National Forest System lands where treatments will occur, and adjacent private lands included within the Savanna Ecosystem Restoration Project Area (Project Area) boundary. The cumulative effects analysis area for wildlife resources encompasses the Manistee National Forest (MNF). The size of this area provides an adequate geographical range to consider the effects that this project may have on the viability of the individual species that are considered in this analysis over the anticipated length of the project (~10 years).

(3.5c) Effects on Federally-Listed Endangered and Threatened Wildlife Species

(3.5d) Karner Blue Butterfly

Status and Distribution

In 1992, the Karner blue butterfly (KBB) was federally-listed as an Endangered species in the United States (USDI Fish and Wildlife Service 2003). KBB occur in heterogeneous oak/pine savanna/barrens habitats with abundant wild lupine (*Lupinus perennis*) (the sole food source for the KBB caterpillar), abundant adult nectar sources, warm season grasses for basking and roosting, and ants to protect larvae from parasites and predators (USDI Fish and Wildlife Service 2003). In addition, to maintain persistent metapopulations, dispersal between subpopulations needs to be maintained by connecting subpopulations with corridors and maintaining an average nearest neighbor distance of ≤1 km between subpopulations (USDI Fish and Wildlife Service 2003). Dispersal usually refers to the movement of individuals within and between suitable habitat sites. Research has shown dispersal of KBB to range from about 600 feet (183 meters) to about 2 miles (3.2 kilometers); however, dispersal distances are generally short, with most movements less than 1/8 mile (200 meters) (Rabe 2001, USDI Fish and Wildlife Service 2003). Detailed information on the ecology of the KBB and its status on the HMNF may be found in the KBB Recovery Plan (USDI Fish and Wildlife Service 2003), the DRAFT Management Strategy (USDA Forest Service 2004a), the Biological Assessment for the Huron-Manistee National Forests Environmental Impact Statement and Forest Plan (USDA Forest Service 2006a), and the Biological Opinion for the Huron-Manistee National Forests Land and Resource Management Plan (USDI Fish and Wildlife Service 2006).

Openings, prairies, savannas, and barrens have declined within the HMNF over the past century due to extensive reforestation and fire control efforts, and the process of natural succession. As naturally occurring open areas filled in with fire-intolerant woody and shade-tolerant herbaceous species, suitable KBB habitat became scarcer. Wild lupine, other important nectar plants, and warm season grasses were shaded out or out-competed. Overstory tree canopies closed, creating more uniform light conditions. KBB corridors disappeared and subpopulations decreased in size and became more isolated. The decline in KBB habitat quality and quantity has led to a reduction in occupied subpopulations within the HMNF.

The Project Area includes the White River and Otto Metapopulation Areas, described in the KBB Recovery Plan (USDI Fish and Wildlife Service 2003) and the DRAFT Management Strategy (USDA Forest Service 2004a). KBB subpopulations within the White River and Otto Metapopulation Areas have declined over the past decade. In the DRAFT Management Strategy (USDA Forest Service 2004a), 48 and 143 KBB subpopulations were identified within the White River and Otto Metapopulation Areas, covering approximately 620 and 848 acres, respectively. In 2009, 21 and 40 KBB subpopulations were identified within the White River and Otto Metapopulation Areas, covering approximately 199 and 240 acres (USDA Forest Service 2009a). Only 29 of the 61 KBB subpopulations monitored in 2009 were occupied; 21 in the Otto Metapopulation Area and 8 within the White River Metapopulation Area (USDA Forest Service 2009a). Not only has the number and acreage of KBB subpopulations declined within the White River and Otto Metapopulations, but also the number of KBB observed during surveys has declined. Within the White River Metapopulation Area, 181, 167, and 53 KBB were observed in 2007, 2008, and 2009 (USDA Forest Service 2009a). Within the Otto Metapopulation Area, 860, 470, and 378 KBB were observed in 2007, 2008, and 2009 (USDA Forest Service 2009a). Eighty-four percent (51 out of 61) of KBB subpopulations occupied in 2009 had Karner blue butterflies observed during field surveys (USDA Forest Service 2009b). Based on analyses of count data recorded in 2009, the estimated minimum KBB abundance was between 3,423 and 3,993 within the Otto Metapopulation Area and between 760 and 885 within the White River Metapopulation Area (USDA Forest Service 2009a).

Neither of the metapopulation areas meets the large viable metapopulation number goal (≥ 6,000) outlined in the KBB Recovery Plan (USDI Fish and Wildlife Service 2003). In addition, marginal habitat conditions are provided within both metapopulation areas, with subpopulations having an average of 2-4% cover of wild lupine and an average of 1-2% cover of blooming nectar plants (USDA Forest Service 2009a). The KBB subpopulations within the White River and Otto Metapopulation Areas also are relatively small, with an average area of 6-9 acres (USDA Forest Service 2009a). Neither metapopulation area has subpopulations distributed over 2/3 of a≥ 10 square mile area with at least 640 acres of suitable habitat (USDA Forest Service 2009a). KBB subpopulations within the White River Metapopulation Area also are mostly isolated and not well connected (USDA Forest Service 2009a). Areas occupied by Karner blue butterfly within the White River and Otto Metapopulation Areas consist of subpopulations that have low numbers of KBB, marginal habitat conditions, are small in size, are not well distributed, and/or are isolated and lack connectivity. As a result, they are subject to a high risk of extirpation from catastrophic events such as wildfire, and currently would not meet recovery goals for establishing a minimum or large viable metapopulation, as described in the KBB Recovery Plan and DRAFT Management Strategy (USDI Fish and Wildlife Service 2003, USDA Forest Service 2004a).

Currently, the Brohman and Bigelow Metapopulation Areas also are at risk of extirpation. Neither of these metapopulation areas meets recovery goals for establishing a minimum or large viable metapopulation (USDA Forest Service 2009a). The number of acres and sites occupied by KBB, and the number of KBB observed during surveys, have declined within both of these metapopulation areas to the point where currently no KBB are found on National Forest System lands (USDA Forest Service 2009a). All 4 known KBB subpopulations within the Bigelow Metapopulation Area occur on private lands (USDA Forest Service 2009a). KBB have not been observed within subpopulations located on National Forest System lands within the Brohman Metapopulation Area since 2005, and no occupied KBB sites are known to occur on non-National Forest System lands (USDA Forest Service 2009a). In addition, no new KBB subpopulations were identified within the Brohman or Bigelow Metapopulation Areas during inventory or presence/absence surveys conducted in 2007, 2008, and 2009 (USDA Forest Service 2009b).

The Forest believes that the following factors might be responsible for apparent KBB declines in the four metapopulation areas (USDA Forest Service 2006a, USDA Forest Service 2009a):

- Habitat loss due to natural succession is continuing at the same level, despite past treatments that have attempted to prevent woody encroachment into suitable KBB habitat. The number of acres of suitable KBB habitat experiencing woody encroachment is greater than the number of acres of suitable KBB habitat treated annually.
- Deer browsing of wild lupine, which might reduce KBB larval survival, is increasing within suitable KBB habitat.
- Weather conditions have shifted between drought conditions and very wet and cold springs and summers, with several spring frosts. As a result, availability of wild lupine and other important nectar plants has decreased within suitable KBB habitat. In addition, these conditions likely decreased over-winter survival of KBB eggs.
- Topography of these units, with low depressional areas, increases the occurrence of growing-season frost pockets that might damage wild lupine and other nectar plants.
- Vehicle/ORV use and dispersed camping occurs within suitable KBB habitat and might kill KBB and/or damage wild lupine and other important nectar plants. Road closures implemented under the Forest Plan's management direction for the White River Semiprimitive Nonmmotorized Area, and camp site closures in occupied KBB habitat that have been implemented under Forest Plan Standards and Guidelines have reduced these impacts in some metapopulation areas (USDA Forest Service 2006b).

Efforts to prevent the extirpation of the KBB have increased dramatically since the Forest Plan was signed in 2006. To meet recovery goals for viable KBB populations, the Forest Plan calls for the restoration and maintenance of 20,300 acres of savannas/barrens within the four designated KBB metapopulation areas and essential KBB habitat on National Forest System lands over the next 50 years (USDA Forest Service 2006b). Since 1992, hand cutting, prescribed burns, mechanical removal of vegetation (i.e., mowing, sheer-cutting, masticating, bulldozing), scarification, seeding/planting, and road closures have been used to manage 927 acres of occupied and 927 acres of unoccupied KBB habitat (USDA Forest Service 2009a). However, 1,148 out of 1,854 acres (62%) that received savanna/barrens restoration treatments were managed after 2005 (USDA Forest Service 2009a). Whereas management activities occurred on an average of 50 acres per year between 1992 and 2005, an average of 287 acres per year were

treated between 2006 and 2009 (USDA Forest Service 2009a). This represents more than a five-fold increase in restoration activities. The amount of acres treated within occupied and unoccupied KBB habitat also has changed. Up until 2005, treatments primarily focused on maintenance of occupied sites (USDA Forest Service 2009a). In 2006, treatments shifted to focusing on savanna restoration in unoccupied areas around and between KBB subpopulations (USDA Forest Service 2009a).

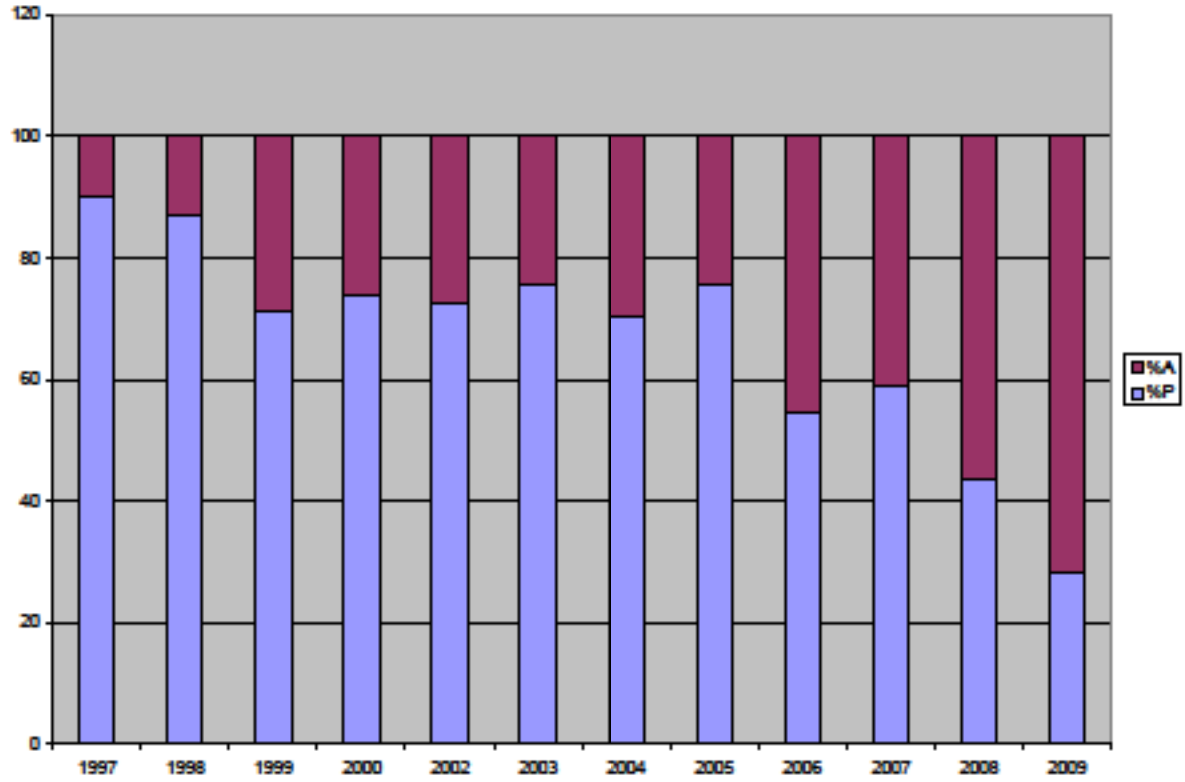
Currently, treatments to restore savanna/barrens for KBB are occurring within the White River Metapopulation Area under the Savanna/Barrens Restoration Project, for which a Decision Memo was signed in 2008 (USDA Forest Service 2008). Treatments to restore occupied KBB openings within the White River and Otto Metapopulation Areas are also occurring under the Karner Blue Butterfly Habitat Restoration Project, for which a Decision Memo was signed in 2009 (USDA Forest Service 2009c). The Proposed Action complements these two restoration efforts by expanding the acreage to be treated for savanna creation and opening restoration, and increasing the number of treatment techniques that can be used to meet restoration goals. For example, under the Karner Blue Butterfly Habitat Restoration Project, only hand tools may be used to remove woody vegetation and seed/plant native nectar species to restore occupied KBB sites (USDA Forest Service 2009c). Under this project, KBB opening restoration would incorporate a combination of mechanical equipment, hand tools, prescribed burning, herbicide application, soil scarification, and seeding/planting activities to reduce overstory and understory cover and to establish native nectar species.

The Baldwin/White Cloud Ranger District has increased dramatically its KBB monitoring program. These efforts include: determining how far designated metapopulation areas within the HMNF are from meeting recovery goals; developing a habitat suitability model for KBB within the MNF; identifying high priority areas to target management; and, evaluating the effectiveness of different management strategies for restoring KBB habitat. Between 2006 and 2009, the number of acres that were monitored for KBB on the Distrct increased by more than three-fold (298 acres in 2006, 843 acres in 2007, 812 acres in 2008, 1,130 acres in 2009). This increase was due largely to increases in volunteer participation in the survey efforts (USDA Forest Service 2009a). These data will be used to focus management efforts in areas where there is a high probability of KBB occurrence and restoration success.

In addition, the District began a demonstration project in 2008 to determine the effectiveness of combining several types of mechanical treatments and prescribed burn prescriptions to restore KBB habitat. Activities conducted for the demonstration project are covered in the Savanna/Barrens Restoration Project (USDA Forest Service 2008). By applying what it learns from small scale demonstration projects at the landscape scale, the District will make restoration treatments more efficient and cost effective.

Based on the analyses of KBB count data, the estimated minimum KBB abundance within the MNF was 2-3 times lower in 2009 (10,333), than in 2008 (27,405) and 2007 (34,916) (USDA Forest Service 2009a). The percentage of sites designated as 'KBB present' has declined within the MNF since 1997 (Figure 3.1). By implementing restoration activities at a landscape scale using an adaptive management approach, as proposed under this project, the Baldwin/White Cloud Ranger District will improve its probability of effectively reversing the negative trend in KBB populations.

Figure 3.4: Changes in monitored Karner blue butterfly sites designated as 'present' and 'absent' between 1997 and 2009 within the Manistee National Forest (USDA Forest Service 2009a).



(3.5e) Direct and Indirect Effects

The primary sources of information for this section are the KBB Recovery Plan (USDI Fish and Wildlife Service 2003), the Biological Opinion on the Programmatic Biological Assessment for the Huron-Manistee National Forests Land and Resource Management Plan (USDI Fish and Wildlife Service 2006), and the Programmatic Biological Assessment for the Huron-Manistee National Forest (USDA Forest Service 2006a).

Alternative 1

Under Alternative 1, the quantity and quality of early successional vegetative types would continue to decline in the Project Area due to fire suppression and natural succession. As remnant openings and savannas/barrens filled in with fire-intolerant woody and shade-tolerant herbaceous species, suitable KBB habitat would likely become scarcer as wild lupine and other important KBB nectar plants are shaded-out or out-competed. Reductions in habitat quality and quantity within the 73 openings currently occupied by KBB would likely maintain the existing trend of decreasing population numbers within the Otto and White River Metapopulation Areas.

Alternative 1 would also not provide for the control of non-native invasive plant species within remnant openings and savannas/barrens. Many non-native invasive plant species may reduce wild lupine and other native plants that provide nectar sources for adult KBB, which could

decrease the numbers and distribution of KBBs within the Forest (USDI Fish and Wildlife Service 2006). Leafy spurge, autumn olive, honeysuckle, Canada thistle, garlic mustard, Cypress spurge, Japanese barberry, sweetclover, Scots pine, and spotted knapweed were among invasive species found during botanical surveys conducted in 2006, 2007, and 2009 within stands proposed for savanna creation or KBB opening restoration treatments. Depending on the species and the abundance, these invasive plants could shade out or out-compete, and subsequently replace, wild lupine and other important KBB nectar plants. Failure to successfully control these invasive species would allow continued infestation and degradation of KBB habitat.

In addition, KBB habitat quantity and quality might decline under this Alternative because it would maintain the current road, trail, and camping densities within the Project Area. These densities are higher than Forest Plan objectives for the White River Semiprimitive Nonmotorized Area (WRSNA) (USDA Forest Service 2006b). In some areas of the Project Area, roads, trails, and concentrated use occur in potential or occupied KBB habitat. Currently, roads occur on 3.6 acres of occupied KBB habitat, and campsites occur on 1.5 acres of occupied KBB habitat. Dispersed camping sites have degraded occupied KBB habitat in the past (USDI Fish and Wildlife Service 2006). In addition, horseback riding occurs on Forest Service roads throughout the Project Area, and cross-county travel is permitted for horseback riding, except where posted signs exclude this form of recreation.

Some roads and trails within the Project Area provide KBB habitat (i.e., wild lupine and other nectar plants growing along roadsides, or road-rut ponds providing watering areas) and/or dispersal corridors. Foot traffic, dispersed camping, horseback riding, and vehicle use along roads and trails and within adjacent openings might damage or disturb KBB habitat (i.e., trampling, removing, or otherwise damaging wild lupine or other important nectar plants); temporarily displace, alter movement, or disrupt normal behavior of KBB (i.e., interfere with dispersal or mating activities). In addition, there would be increased risk of vehicle collisions, visitors directly harming, harassing, or killing KBB (all life stages), illegal collection, and wildfires (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). Traffic along roads and trails might increase the risk of off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles), cross-country horseback riding, and dispersed camping, which might adversely affect KBB habitat via soil erosion and compaction, increases in bare ground, reduction in nectar plants, and increases in non-native invasive species (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). Use of roads and trails that are close to, or pass through, potential or occupied KBB habitat have the greatest potential to have these direct and indirect effects. Thus, maintaining current levels of access and use would likely increase the risk of mortality and reduce habitat quantity and quality for KBB.

As KBB habitat quantity and quality decreases under Alternative 1, occurrences of KBB within subpopulations would likely decline within the Project Area. Surviving subpopulations would become even more isolated and disconnected, and thus subject to a higher risk of extirpation from catastrophic events. Without management, the HMNF would likely not meet the recovery goals for establishing two large viable metapopulations in the White River and Otto Metapopulation Areas (USDI Fish and Wildlife Service 2003). Overall, the "No Action" Alternative is likely to have adverse direct and indirect effects on KBB.

Alternatives 2 and 3

KBB opening restoration, proposed under Alternatives 2 and 3, would use a combination of hand cutting, mowing, brush hogging, mechanical slash/woody debris removal, prescribed burning, herbicide application, soil scarification, and seeding/planting activities to reduce tree/shrub density to an average <15% canopy cover and cover of undesired vegetation less than 2 meters in height to an average of <25% cover. In addition, these alternatives would establish 5-15% cover of wild lupine, 5-15% cover of other nectar plants, 60% presence of desired savanna plant species, and less than 5% presence of non-native invasive species. Disturbance from KBB opening restoration might displace or kill KBB within the 73 openings currently occupied by KBB within the Project Area. KBB have limited mobility and likely would not escape proposed management activities. While some KBB adults might be able to move out of treated areas, eggs and larvae are immobile and thus are particularly vulnerable and likely to be crushed during mechanical treatments such as brush hogging or discing, burned during prescribed burning, or trampled during hand cutting. Prescribed burning might directly affect KBB by killing all life stages. All other management activities proposed under KBB opening restoration would be prohibited between March 15 and August 15, which would minimize potential direct adverse effects on larval and adult life stages of KBB (see conservation measures for KBB in Appendix A of this document). However, these activities might still directly affect KBB by destroying overwintering eggs.

KBB opening restoration management activities also might damage or destroy wild lupine, reducing the availability of the sole food source for KBB caterpillars. KBB eggs and larvae primarily occur in association with wild lupine (USDI Fish and Wildlife Service 2003). As such, activities that damage or destroy wild lupine are more likely to destroy KBB eggs and larvae. Implementation of the proposed treatments may also temporarily disrupt the normal behavior of KBB, such as altering KBB dispersal or limiting the use of foraging or mating areas, potentially affecting productivity. KBB are most likely to be directly affected during the implementation of treatments by heavy equipment use (e.g., harvesters, skidders, trucks, bulldozers, discing, plowing) and prescribed burning. In addition, vehicle use and foot traffic along roads and within openings during management activities may temporarily increase the level of disturbance (e.g., human activity, noise, and habitat degradation), damage wild lupine and other nectar sources, temporarily displace, alter movement, or disrupt normal behavior of KBB, and increase the risk of vehicle collisions, and visitors directly harming, harassing, or killing KBB. However, given that few (≤10) KBB are present within most (84%) occupied KBB openings, and wild lupine and other nectar plants cover a small portion (1-4%) of occupied openings (USDA Forest Service 2009a, USDA Forest Service 2009b), the likelihood that KBB eggs, larvae, or adults, or wild lupine and other nectar plants would be exposed to KBB opening restoration activities is very low.

Savanna creation, prescribed burning, red pine thinning, and oak/aspen clearcuts, proposed under Alternatives 2 and 3, may also displace or kill adult KBB dispersing into stands that are adjacent to the 73 occupied openings. However, no occupied KBB subpopulations were located within areas proposed for these treatments during wildlife surveys conducted in 2006, 2007, and 2009. In addition, these proposed treatment areas are mostly forested and provide unsuitable habitat for KBB. Given that few (≤10) KBB are present within most (84%) occupied KBB openings and most areas proposed for savanna creation, prescribed burning, red pine

thinning, and oak/aspen clearcuts provide unsuitable habitat for KBB, it is highly unlikely that KBB would be directly affected by these treatments.

Management for the KBB may be detrimental to the species if not planned and executed appropriately (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). The season, intensity, and frequency of management activities (particularly prescribed burns) could have detrimental effects on KBB through the killing of eggs, larvae, or adults. For example, operations during the larval and flight periods between March and August have the greatest potential of causing disturbance, damaging wild lupine and other nectar sources, and killing or disrupting the behavior of KBB. While KBB adults and larvae are less likely to be affected directly by management activities conducted between September and April (outside the larval and flight periods), implementation of treatments may still have short-term adverse direct effects via the crushing or burning of eggs (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). In addition, restoration activities could eliminate a KBB subpopulation if they are conducted on the majority of an occupied KBB opening, and there is no source of individuals within a short distance to allow for repopulation (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). For example, prescribed burning may threaten KBB populations if burning is conducted on the majority of a KBB site at one time, and if high intensity fires are used at frequent intervals (USDI Fish and Wildlife Service 2003). Mowing between late spring and early summer could damage wild lupine, eliminating food for KBB larvae, and mowing during adult nectaring periods might greatly reduce flower number and nectar availability (USDI Fish and Wildlife Service 2003). The mowing of wild lupine and nectar plants before seeds mature and disperse may reduce the reproduction of these food plants. This would have a long-term detrimental effect on KBB (USDI Fish and Wildlife Service 2003).

By implementing conservation measures outlined for KBB in Appendix A within occupied or potential unoccupied KBB habitat, management for KBB would be planned and executed to minimize adverse effects on KBB adults, larvae, and eggs and wild lupine and other nectar sources. Conservation measures for occupied KBB habitat would be implemented within the 73 openings covering 519 acres occupied by KBB. Based on the overlap of historical occurrences of savanna/barrens habitats and KBB, 2,542 acres within the Project Area have the potential to be restored to suitable KBB habitat. Conservation measures for potential unoccupied KBB habitat would be implemented within the 2,542 acres proposed for savanna creation under Alternatives 2 and 3. Should any new occupied KBB habitat be identified during treatment of units or in future surveys, these same conservation measures would be applied.

Conservation measures include all Forest Plan Standards and Guidelines (USDA Forest Service 2006b), as well as other suggested management practices described in the KBB Recovery Plan (USDI Fish and Wildlife Service 2003) and the DRAFT Management Strategy (USDA Forest Service 2004a). Standards and guidelines include, but not are limited to, the following:

1. Planning, both annually and cumulatively for the term of the project, for the appropriate amount, spatial arrangement, and rotation schedule of restoration sites to maximize habitat recovery and recolonization potential;
2. Seasonal time restrictions for each restoration technique to minimize the potential for direct effects and to maximize effectiveness;
3. Minimize incidental habitat damage due to equipment or methodology; and

4. Pre- and post-treatment monitoring for KBB and habitat responses (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006).

The monitoring of treatment results and progress allows for any necessary adjustments to be made to restoration techniques (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). For example, to minimize the number of KBB killed and the amount of suitable KBB habitat impacted from prescribed burns, occupied KBB openings would be divided into at least 3 burn units based on the number of KBB and habitat conditions (i.e., occurrence of wild lupine and other nectar sources), the most degraded 1/3 would be treated first, and no more than 1/3 of an occupied opening would be burned in any one year. In addition, occupied KBB openings scheduled for burning would ideally be within ¼ mile of unburned occupied KBB openings to aid recolonization. Using an approximate 4 year burn frequency would also give the burned areas time to regenerate and become repopulated by KBB so they could aid in recolonization when other units within occupied KBB openings were burned.

Except for prescribed burning, all of the other management activities would be prohibited between March 15 and August 15, during the larval and flight periods. This would minimize the adverse effects to KBB adults and larvae and important nectar plants such as wild lupine. Forest Service employees and contractors who perform management activities also would be educated to recognize and avoid wild lupine. In addition, annual surveys would be conducted to provide up-to-date information on distribution and status of KBBs, which would be applied to management activities to minimize take.

Some of the conservation measures outlined for occupied KBB habitat in Appendix A are not specified in the Forest Plan Standards and Guidelines (USDA Forest Service 2006b), but are consistent with the management suggestions proposed in the Standards and Guidelines, the KBB Recovery Plan (USDI Fish and Wildlife Service 2003), and the DRAFT Management Strategy (USDA Forest Service 2004a). For example, these conservation measures allow a combination of manual or mechanical tree/shrub removal, herbiciding, and/or seeding/planting to occur following a prescribed burn on 1/3 of an occupied KBB opening, as long as all treatments occur within the burned unit, during the same year that the area was burned. By combining treatments, restoration goals for occupied KBB habitat might be achieved more efficiently and effectively. For example, a prescribed burn might remove leaf litter and reduce fire-intolerant species that out-compete important nectar plants like wild lupine, but only top kill woody vegetation less than 3 inch dbh. By following the burn with hand cutting, larger shrubs and trees could be removed that are not killed during the prescribed burn, increasing incident sunlight and subsequently favoring the establishment of fire-tolerant nectar species. In addition, the desired composition of nectar plants might be achieved more efficiently and effectively by broadcast seeding burned areas in the fall. Also, some non-native invasive species, such as autumn olive or Japanese barberry, might be controlled more efficiently and effectively by following a prescribed burn with herbicide application. Although this conservation measure was not specified in the Forest Plan Standards and Guidelines (USDA Forest Service 2006b), it is consistent with the Standards and Guidelines given that the conservation measures for subsequent restoration techniques would be implemented. Minimal additional adverse effects to KBB or suitable KBB habitat would be likely to occur within the unit since: 1) it has already been burned; 2) no more than 1/3 of an occupied site would be treated within a given year; and 3) it represents the most degraded portion of an occupied site.

Another conservation measure outlined for occupied KBB habitat in Appendix A that is not specified in the Forest Plan Standards and Guidelines (USDA Forest Service 2006b) allows mechanical equipment, of similar size and weight to a mower or brush hog, to be used to remove slash/woody debris within an occupied KBB opening. This measure is consistent with the management suggestions proposed in the Standards and Guidelines, the KBB Recovery Plan (USDI Fish and Wildlife Service 2003), and the DRAFT Management Strategy (USDA Forest Service 2004a). Mechanical removal of slash/woody debris would be prohibited between March 15 and August 15, and would occur on no more than half of an occupied KBB opening each season unless there is a colonization source within one-fourth mile that has the capability to recolonize the opening. Cut vegetation within an occupied KBB opening that might contain KBB eggs would be left unless the cut vegetation is collected and placed in another suitable KBB habitat site. In occupied KBB openings that have experienced heavy woody encroachment, it is logistically unfeasible to remove slash/woody debris by hand after woody vegetation has been cut. By allowing the use of mechanical equipment, such as a farm tractor with a trailer, that is the size and weight of a mower or brush hog, the conservation measure requiring slash not to exceed 20 percent of an area would be achieved more efficiently and effectively. This conservation measure is consistent with the Forest Plan Standards and Guidelines (USDA Forest Service 2006b) given that the adverse effects of mechanical removal of slash/woody debris using equipment of similar size and weight to a mower or brush hog are assumed to be similar to those from mowing or brush hogging, and, as such, the conservation measures outlined for these two activities in Appendix A would be applied.

When management is planned and executed appropriately (e.g., conservation measures such as those in Appendix A are implemented), prescribed burning and mechanical treatments within occupied KBB habitat have been shown to not adversely affect KBB or wild lupine. For example, Pickens (2006) compared KBB abundance in burned, mowed, and unmanaged sites and found no significant difference in male or female abundance during the first brood. In the second brood, there were significantly more females in burned areas compared to the other two treatments, and significantly more males in burned and mowed areas compared to unmanaged areas (Pickens 2006). In addition, King (2003) compared control, mowed, and burned treatment effects on KBB populations and the cover of associated herbaceous plants, and found no treatment-related changes in KBB density or cover of wild lupine. Wild lupine responses also did not significantly differ among herbicide and mechanical treatments applied at annual, four, and eight year intervals in a study conducted by Forrester et al. (2005). However, wild lupine cover, clump size, and density of stems per clump increased following application of treatments in general (Forrester et al. 2005). The number and cover of nectar species, total herbaceous cover, and species richness also responded positively to treatment overall (Forrester et al. 2005). Also, lupine abundance and the proportion of lupine stems with signs of feeding were positively correlated with military training activities, suggesting that maintenance of lupine habitat can be achieved in concert with human uses such as military training when planned and executed appropriately (Smith et al. 2002). In general, many methods for removing and suppressing tree and shrub canopy can have a net positive effect on wild lupine and KBB, and should be timed and carried out in ways that minimize harm to the butterfly, wild lupine, and nectar plants (USDI Fish and Wildlife Service 2003).

Under Alternatives 2 and 3, strip/patch or spot application of gylphosate, triclopyr, or imazapyr is proposed to control non-native invasive species and to control persistent woody

vegetation within savanna creation and KBB opening restoration areas. Ecological risk assessments conducted for glyphosate, triclopyr, and imazapyr suggest that use at rates commonly used by the Forest Service poses little or no risk to wildlife (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). The proposed herbicides are not highly toxic to avian receptors such as bald eagles, to insect species such as Karner blue butterflies, to reptile species such as Blanding's turtle or wood turtle, or to the small mammal, amphibian, and fish species that form the chief prey of carnivores such as red-shouldered hawks, northern goshawks, and bald eagles (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). Proposed herbicides are not cholinesterase inhibitors such as organophosphate or a carbamate insecticide (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. Nor are the proposed herbicides chemically related to chlorinated hydrocarbon insecticides such as DDT that are highly persistent in the environment and known for causing eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys. Herbicide toxicity and risk data (Appendix C) for mammalian, aquatic, avian, and terrestrial wildlife species suggest glyphosate, triclopyr, and imazapyr are generally safe to mammals, birds, and other wildlife if used in accordance with the manufacturer label.

In addition, glyphosate, triclopyr, and imazapyr are not expected to bioaccumulate in the food chain (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). KBB could be exposed to herbicides by direct contact with herbicide spray or with recently treated foliage. Oral exposure also could occur by ingesting contaminated nectar or by drinking from water sources that have received contaminated surface runoff. However, KBB are not likely to come in direct contact with herbicide spray or recently treated foliage, or consume contaminated nectar or water because only strip/patch or spot application of herbicides would be used to treat small areas within occupied KBB habitat. Research to date suggests that glyphosate can be used with minimal direct impact on the Karner blue butterfly (USDI Fish and Wildlife Service 2003). Studies indicate that glyphosate-imazapyr mixtures may be effective in reducing woody cover with positive effects on wild lupine populations (USDI Fish and Wildlife Service 2003). Sucoff et al. (2001) suggested that glyphosate-triclopyr mixtures may cause a slight (2%) reduction in the reproductive success of KBB.

Poorly timed or poorly located use of herbicides can have a negative effect on KBB, by killing or suppressing wild lupine or important nectar plants (USDI Fish and Wildlife Service 2003). Application of herbicides in KBB occupied areas is best done after wild lupine and nectar plants senesce (USDI Fish and Wildlife Service 2003). Any adverse effects to KBB and its habitat would be minimized by prohibiting herbicide application in or adjacent to occupied KBB habitat between April 1 and August 15, except when the wind is not blowing toward the habitat and there is a minimum buffer of 100 feet (30 m) between the habitat and treatment area, and by avoiding wild lupine during herbicide application, as outlined in the conservation measures for KBB in Appendix A. These conservation measures would ensure that herbicide applications are not completed at a time and place where there would be adverse effects to the species (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006).

Vegetative management proposed under Alternatives 2 and 3 would likely have a greater effect on local KBB populations through habitat change. Implementation of treatments might temporarily reduce densities of wild lupine and other native flowering plants that serve as food

sources for KBB larvae and adults, and/or the cover of warm season grasses that are used by adult KBB for basking and roosting. For example, prescribed burns might damage vegetation and increase the amount of bare ground within treated KBB openings, temporarily decreasing cover and the abundance of native grasses, herbs, wildflowers, and fruit-bearing shrubs. In addition, mechanical equipment such as a mower or brush hog might run over and destroy ant mounds during operations, which might subsequently increase the rates of parasitism and predation on KBB larvae. Without sufficient knowledge of what plant species are present on a given site and their response to different management activities, implementation of proposed treatments might increase undesired plant species. For example, fire may either increase the abundance of invasive species, such as spotted knapweed, and/or native species, such as Pennsylvania sedge, that compete with wild lupine and nectar plants.

Disturbance from restoration activities also might create conditions favorable for the establishment of non-native invasive species, such as spotted knapweed and St. John's wort. While non-natives like spotted knapweed do provide nectar sources for KBB, they tend to choke out some native plants, and consequently dominate and reduce overall site biodiversity, which might increase the risk of extirpation of KBB subpopulations (USDI Fish and Wildlife Service 2006). Proposed herbicide treatments under Alternatives 2 and 3 would minimize the occurrence of non-natives and favor more desirable native nectar species. Effects of herbicides on the growth and flowering of wild lupine and other nectar plant species varies, and at times might result in a temporary reduction in habitat quantity and quality for KBB (USDI Fish and Wildlife Service 2003). Potential adverse indirect effects to KBB habitat quality are expected to be minimized by implementing the conservation measures outlined for KBB in Appendix A, which maximize habitat recovery potential, minimize incidental habitat damage due to equipment or methodology, and use pre- and post-treatment monitoring to ensure treatments are efficient and effective.

Under Alternatives 2 and 3, savanna creation and KBB opening restoration also might improve habitat for herbivores occurring within the Project Area. Wild lupine is browsed by deer, woodchucks, and insects (USDI Fish and Wildlife Service 2003). In particular, deer might experience an increase in habitat quantity and quality, potentially causing localized increases in deer numbers (USDI Fish and Wildlife Service 2006) and increased herbivory on wild lupine within savanna creation and KBB opening restoration areas (USDI Fish and Wildlife Service 2006). KBB eggs and larvae primarily occur in association with wild lupine (USDI Fish and Wildlife Service 2003), so herbivory on wild lupine also likely would destroy KBB eggs and larvae. High deer densities can devastate KBB habitat and cause direct mortality by the ingestion of larvae (Schweitzer 1994). Schweitzer (1994) recommends that deer populations be managed to levels where no more than 15 percent of lupine flowers are consumed. However, the management of deer populations is outside Forest Service jurisdiction and authority. In the long-term, deer herbivory might decrease the overall rate of KBB reproduction by limiting lupine growth (USDI Fish and Wildlife Service 2006). It is unknown whether other birds or mammals that might benefit from savanna creation and KBB opening restoration treatments such as wild turkey cause significant mortality at any life stage of the Karner blue butterfly (USDI Fish and Wildlife Service 2003). However, bird beak-marks have been observed occasionally on the wings of adult KBB (USDI Fish and Wildlife Service 2003).

Much of the habitat change expected from savanna creation and KBB opening restoration treatments proposed under Alternatives 2 and 3 would likely have beneficial indirect effects to local KBB populations. Prescribed burning would be used to suppress undesirable plant species, enhance the diversity and abundance of desirable plant species, raise soil pH, and expose mineral soils. Woody plant cover would be reduced, increasing the incident sunlight at ground level (USDI Fish and Wildlife Service 2003). Hand cutting, mowing, brush hogging, and herbicide application would mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks, suppressing undesirable herbaceous and woody plants and increasing incident sunlight at ground level (USDI Fish and Wildlife Service 2003). Soil scarification would mimic certain effects of fire by exposing mineral soils and providing sunlit seed beds to promote the germination and growth of lupine and nectar plants (USDI Fish and Wildlife Service 2003). Soil scarification would be used when wild lupine or nectar plant densities are insufficient to meet KBB habitat management objectives, and would be followed by seeding or planting. Seeding/planting activities would increase the abundance of the KBB's host plant, adult nectar sources, and warm season grasses for basking and roosting. Herbicide treatments also would reduce stump sprouting of woody vegetation and establishment of non-native invasive species within treated areas, which could impede the establishment of wild lupine and other desired nectar sources through shading or competition (USDI Fish and Wildlife Service 2003).

Overall, savanna creation and KBB opening restoration would reduce overstory and understory cover, and increase sunlight and the overall open nature of the savanna/barrens habitats (USDI Fish and Wildlife Service 2006). These treatments would subsequently shift the competitive advantage away from shade-tolerant plant species and provide the variable light conditions required to promote the growth of wild lupine (the sole food source for the KBB caterpillar), other KBB nectar plants such as black-eyed Susan and horsemint, and native grasses such as big blue stem, little blue stem, and Indian grass. The expected net effect of savanna creation and KBB opening restoration would be improved habitat conditions for KBB. This would be evidenced by increased production and biomass of wild lupine and other important KBB nectar plants and the suppression of woody vegetation (USDI Fish and Wildlife Service 2006). These improved habitat conditions would likely increase adult foraging and breeding, and the development of eggs and larvae (USDI Fish and Wildlife Service 2006).

Currently, suitable KBB habitat occupies 519 acres within the Project Area. Without management, the quantity and quality of this habitat would continue to decline over time due to uncontrolled encroachment of woody vegetation and subsequent reductions of wild lupine and other nectar plants. Savanna creation and opening restoration activities would create up to 3,061 acres of suitable KBB habitat under Alternatives 2 and 3. This acreage would contribute to the Forest Plan's goal to restore 20,300 acres of savannas/barrens within the four designated KBB metapopulation areas and essential KBB habitat (USDA Forest Service 2006b).

Management activities under Alternatives 2 and 3 would create a heterogeneous habitat mosaic that provides subhabitat variation in tree canopy and shrub cover, plant community composition, thermal environment, topography, and soil moisture required for mating, roosting, adult feeding, oviposition (i.e., egg laying), and egg and larval growth and survival. In addition, these alternatives would develop a habitat design that maximizes connectivity between subhabitat types within subpopulations, as well as between subpopulations within the

Otto and White River Metapopulation Areas. This would meet the requirement to promote dispersal and support persistent viable metapopulations. By creating a heterogeneous habitat mosaic that provides subhabitat variation for all KBB life stages and maximizes connectivity between subhabitat types within and between KBB subpopulations, Alternatives 2 and 3 would increase the acreage, distribution, and connectivity of suitable KBB habitat as directed by the KBB Recovery Plan (USDI Fish and Wildlife Service 2003), the DRAFT Management Strategy (USDA Forest Service 2004a), and the Forest Plan (USDA Forest Service 2006b). Alternatives 2 and 3 would also follow an adaptive management approach, modifying treatments in response to effectiveness monitoring and using demonstration projects to determine the most efficient and effective restoration techniques. This would increase the probability of restoration success within the Project Area. As management activities increase the amount of suitable KBB habitat around and between extant subpopulations and increase dispersal opportunities between occupied and unoccupied habitat patches, the number of occupied KBB subpopulations and the total number of KBB within Otto and White River Metapopulation Areas would likely increase.

Overall, vegetation management activities proposed under Alternatives 2 and 3 may have direct and indirect effects on KBB within the Project Area. However, KBB opening restoration and savanna creation are necessary to preserve, enhance, and create habitat for KBB to promote persistent populations within the Otto and White River Metapopulation Areas. Without these treatments, KBB populations would likely continue to decline within the Otto and White River Metapopulation Areas, and surviving subpopulations would become even more isolated and disconnected, and thus subject to a higher risk of extirpation from catastrophic events. KBB opening restoration and savanna creation are expected to have an overall beneficial effect on KBB populations by increasing the acreage, distribution, and connectivity of suitable habitat with the goal of establishing two large viable metapopulations in the White River and Otto Metapopulation Areas as directed by the KBB Recovery Plan (USDI Fish and Wildlife Service 2003), the DRAFT Management Strategy (USDA Forest Service 2004a), and the Forest Plan (USDA Forest Service 2006b).

Off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles), cross-country travel via foot or horseback, and dispersed camping may increase within areas proposed for savanna creation and KBB opening restoration under Alternatives 2 and 3. Increased recreational use might reduce the quantity and quality of potential and occupied KBB habitat by:

1. Damaging or disturbing KBB habitat elements (i.e., trampling, removing, or otherwise damaging wild lupine or other important nectar plants, or increasing non-native invasive species);
2. Increasing the risk of vehicle/KBB collisions, visitors directly harming, harassing, or killing KBB (all life stages);
3. Temporarily displacing, altering movement, or disrupting normal behavior of KBB (i.e., interfere with dispersal or mating activities);
4. Increasing soil disturbance, erosion, compaction, and the amount of bare ground;
5. Increasing the risk of illegal collection; and/or
6. Wildfires (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006).

Potential adverse effects would be minimized with the implementation of the conservation measures outlined for KBB in Section Appendix A. Signs would be installed within areas proposed for savanna creation and KBB opening restoration treatments explaining the benefits

of restoring native plant communities and requesting recreationists to stay on designated roads and trails. If damage from recreational use within treated areas is noted in KBB habitat, public access to managed savannas and openings would be blocked via a variety of methods such as barrier posts or piling brush around the perimeter of treatment areas.

Recreation and transportation management activities proposed under Alternatives 2 and 3 would have primarily beneficial effects to local KBB subpopulations within the Project Area by reducing the conflicts that would occur between humans and KBB as a result of these activities. Following the Forest Plan management direction for the WRSNA all Forest System roads that are currently open within the WRSNA would be closed under Alternatives 2 and 3. Both Alternatives also propose the development of a parking area for motorized vehicles within the WRSNA. In addition, under Alternatives 2 and 3, the number of motorized-dependent camping sites would be limited to 11 designated sites. Currently, roads occur on 3.6 acres of occupied KBB habitat, and campsites occur on 1.5 acres of occupied KBB habitat.

The White River Metapopulation Area occurs within the WRSNA. Under Alternatives 2 and 3, all Forest System roads and campsites that currently occur in potential or occupied KBB habitat within the White River Metapopulation Area would be closed. All dispersed motorized camping sites that occur within occupied KBB habitat in the Otto Metapopulation Area also would be closed under Alternatives 2 and 3. However, neither Alternative proposes closing all Forest System roads within the Otto Metapopulation Area. Under Alternative 2, 0.2 miles of Forest System roads would be closed to motorized use within occupied KBB habitat in the Otto Metapopulation Area; Forest System roads would still occur on 0.8 acres of occupied KBB habitat. Alternative 3 would reduce human access and use more than Alternative 2 by closing an additional 0.7 miles of Forest System roads that occur within occupied KBB habitat to motorized use, with the exception of seasonal snowmobile use. However, Forest System roads would still occur on 0.3 acres of occupied KBB habitat in the Otto Metapopulation Area under Alternative 3.

By closing roads and dispersed motorized camping sites that occur within potential or occupied KBB habitat, as proposed under Alternatives 2 and 3, human use would be less likely to damage or disturb KBB habitat (i.e., trampling, removing, or otherwise damaging wild lupine or other important nectar plants); temporarily displace, alter movement, or disrupt normal behavior of KBB (i.e., interfere with dispersal or mating activities); or result in vehicle/KBB collisions, visitors directly harming, harassing, or killing KBB (all life stages), illegal collection, and wildfires. Reduced traffic along roads also would likely decrease the risk of off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles) and cross-country travel, which might adversely affect KBB habitat via soil erosion and compaction, increases in bare ground, reduction in nectar plants, and increases in non-native invasive species. Roads and trails that border savanna creation and KBB opening restoration treatments would likely experience an increase in nectar plant availability, increasing the quality and quantity of KBB dispersal corridors within the Project Area.

Human use and its associated impacts (i.e., damaging wild lupine or other habitat elements, killing or disrupting the behavior of individual KBB, spreading non-native invasive species, soil disturbance or compaction) might adversely affect KBB where county roads and Forest System roads remain open to motorized use within potential and occupied KBB habitat. Potential

adverse effects from Forest System roads that would remain open within KBB habitat would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A. Signs and barriers would be installed along all Forest System roads that would still occur within occupied KBB habitat, to prevent off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles) and dispersed camping. If Forest System roads and their associated uses are found to adversely impact KBB or its habitat, they would be relocated or decommissioned. Potential adverse effects from county roads that would remain open to motorized use within potential and occupied KBB habitat in the White River and Otto Metapopulation Area also would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A.

Currently, horseback riding occurs on Forest System roads throughout the Project Area, and cross-country travel is permitted for horseback riding, except where posted signs exclude this form of recreation. Under Alternative 2, cross-country travel for horseback riding would no longer be permitted within the WRSNA, and thus the White River Metapopulation Area. Horseback riding would be limited to a 19.7 mile designated trail which occurs outside potential and occupied KBB habitat. In addition, Alternative 2 proposes the development of a day-use parking area for horse rigs within the WRSNA, and would require the removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the WRSNA. Alternative 2 also would allow for the watering of horses with buckets at identified permanent water sources on National Forest System lands. Alternative 3 would reduce this form of non-motorized use more than Alternative 2 by prohibiting horseback riding within the WRSNA. Neither Alternative would reduce horseback riding within the Otto Metapopulation Area. Cross-country travel for horseback riding and riding along Forest System roads would still be permitted within the Otto Metapopulation Area under Alternatives 2 and 3. In addition, under Alternatives 2 and 3, horseback riding would still occur on county roads that occur within potential or occupied KBB habitat within the White River and Otto Metapopulation Areas.

Because of their relatively large weight and small area in contact with ground, horses have a relatively high potential for environmental damage: more than 20 times the pressure of a man wearing boots and more than twice the pressure by a trail bike or four-wheel drive vehicle (Landsberg, et. al. 2001). Horse use has been shown to result in soil erosion and compaction (Cole and Spildie 1998, Deluca et al. 1998, Campbell and Gibson 2001, Pickering et al. 2009). In addition, horse use has been shown to damage forbs and shrubs via trampling and grazing, and cause defoliation and nutrient enrichment by urination and defecation, reducing plant height and biomass and changing plant species composition along trails (Cole and Spildie 1998, Pickering et al. 2009). Studies also have shown that horses can transport the seeds of non-native invasive species in their manure and thus have the potential to spread invasive species (Campbell and Gibson 2001, Landsberg, et. al. 2001, Cosyns, et. al. 2005, Wells and Lauenroth 2007, Pickering, et. al. 2009, Stroh and Struckhoff 2009, Pickering and Mount 2010). The risk of invasive species establishment is highest when manure is deposited in disturbed, damp sites, especially off-track (Landsberg, et. al. 2001).

In addition to adversely affecting soil and vegetation, horse use has been reported as a contributing factor to the decline of several invertebrate species. Vaughan and Black (2002) reported that within one site occupied by the Taylor's checkspot butterfly, 15-16 horses

trampled much of the area containing Indian paintbrush (the larval hostplant) and might have played a role in the extirpation of the Taylor's checkerspot from the site. Development of the Mt. Adams Horse Camp at Bugle Springs in the Gifford Pinchot National Forest was expected to be detrimental to Mardon skippers as a result of trampling by humans and horses, and grazing by horses within Mardon skipper habitat (Black, et. al. 2002). Recreation also has been found to disrupt the normal behavior of KBB and other listed butterfly species, potentially reducing availability of suitable habitat and reducing productivity. Hiking, jogging, and dog walking along trails in occupied KBB habitat at Indiana Dunes National Lakeshore was found to significantly disturb KBB (personnel communication, Dr. Tory Bennett, Oregon State University, May 9, 2010). Post-disturbance female KBBs flew for longer periods of time than male KBBs before returning to natural behavior, such as ovipositing, nectaring, host plant searching behavior and basking (Ibid). Empirical data suggests that if female KBB are frequently disturbed, they select host plants further from trails, essentially degrading the quality of KBB habitat in proximity to trails and reducing the total amount of suitable habitat available to females (Ibid). These results have implications for female KBBs in terms of energy expenditure (potentially impacting their survival and egg production), their oviposition rate (potentially decreasing the number of eggs laid over an individual's flight period), and host plant selection (potentially limiting females from ovipositing on lupines near trails). KBB sensitivity to horse use along trails in occupied habitat would likely be greater than hiking, jogging, and dog walking.

By reducing horseback riding within potential or occupied KBB habitat within the WRSNA as proposed under Alternatives 2 and 3, this non-motorized use would be less likely to trample KBB (all life stages); temporarily displace, alter movement, or disrupt normal behavior of KBB (i.e., interfere with dispersal or mating activities); damage wild lupine or other important nectar plants; reduce presence and productivity of savanna nectar species; increase non-native invasive species; or increase soil disturbance, erosion, soil compaction, and the amount of bare ground. Requiring removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the WRSNA also likely would reduce the risk of introducing and spreading non-native invasive species within the Project Area. Allowing for watering horses with buckets at identified permanent water sources is not expected to affect KBB or its habitat, as the watering locations would not occur within potential or occupied KBB habitat.

Horseback riding and its associated impacts (i.e., damaging and reducing wild lupine or other important nectar species, killing or disrupting the behavior of individual KBB, spreading non-native invasive species, increasing soil disturbance, erosion, compaction, and bare ground) might adversely affect KBB where county roads, Forest System roads, and National Forest System lands remain open to this non-motorized use within potential and occupied KBB habitat. Potential adverse effects from cross-country travel and horseback riding along Forest System roads within potential and occupied KBB habitat in the Otto Metapopulation Area would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A. Signs and barriers would be posted to ensure the public stays on Forest System roads within occupied KBB habitat. If damage from horseback riding is noted within occupied KBB habitat, Forest System roads providing access to damaged occupied sites would be relocated or decommissioned. Signs would be posted to ensure the public stays on roads within unoccupied KBB habitat. If damage from horseback riding is noted within unoccupied

KBB habitat, barriers would be installed to ensure the public stays on Forest System roads. Potential adverse effects from county roads that would remain open to horseback riding within potential and occupied KBB habitat in the White River and Otto Metapopulation Areas also would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A.

Overall, recreation management activities proposed under Alternatives 2 and 3 would likely decrease the risk of mortality and improve habitat quantity and quality for KBB within the Project Area. Alternative 3 would reduce potential adverse effects of recreational use to KBB and its habitat more than Alternative 2, given that it proposes a greater reduction in human access and use within potential and occupied KBB habitat. Both Alternatives would meet Forest Plan management objectives for the WRSNA (USDA Forest Service 2006b).

(3.5f) Cumulative Effects

Increases in human populations and associated land development, road construction, and recreational uses are expected on private lands within the MNF. These activities would likely result in the degradation and permanent loss of KBB habitat and directly impact individual Karner blue butterflies by:

- Increasing the level of disturbance (e.g., human activity, noise, and habitat degradation);
- Damaging wild lupine and other important KBB nectar plants;
- Temporarily displacing, altering movement, or disrupting normal behavior of KBB; and
- Increasing the risk of vehicle/KBB collisions, wildfires, visitors directly harming, harassing, or killing KBB (all life stages), illegal collection, dispersed camping, and cross country travel.

Additional actions performed on private lands that may adversely affect KBB in the future within the MNF are fire suppression, mowing and grazing, off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles), application of pesticides, and timber harvest. In addition, mineral developments are reasonably certain to occur in the foreseeable future within the MNF and have the potential to cumulatively affect KBB and its habitat. Although land development activities may increase non-forested areas on private lands within the MNF, herbaceous species favorable to KBB are not likely to increase proportionately. Overall, habitat quantity and quality for the Karner blue butterfly and KBB occurrences would likely decline on private lands within the MNF. As a consequence, suitable KBB habitat on federal lands within the MNF is likely to become more important in the future.

The Forest Plan directs restoration and maintenance of 20,300 acres of savanna/barrens within designated KBB population management areas and essential KBB habitat within the HMNF (USDA Forest Service 2006b). Within the White River and Otto Metapopulation Areas, 2,814 and 2,209 acres (respectively) are proposed to be treated to develop savanna/barrens and openings that are accessible and usable by Karner blue butterflies (USDA Forest Service 2004a). Savanna creation and KBB opening restoration treatments proposed under this project would help achieve this goal. Implementation of the conservation measures presented above in Appendix A would minimize potential adverse effects to KBB and its habitat on National Forest System lands within the Project Area. Although increases in human populations and associated

land uses and developments are expected within the MNF in the future, positive effects of Forest Service projects such as the Proposed Action should mitigate potential the negative effects of activities on private lands.

In addition, current treatments to restore savanna for KBB are occurring on 365 acres within the White River Metapopulation Area under the Savanna/Barrens Restoration Project (USDA Forest Service 2008). Treatments to restore occupied KBB openings on 431 acres within the White River and Otto Metapopulation Areas also are occurring under the Karner Blue Butterfly Habitat Restoration Project (USDA Forest Service 2009c). The activities included under Alternatives 2 and 3 complement these two restoration efforts by expanding the acreage to be treated for savanna creation and opening restoration, and increasing the number of treatment techniques that can be used to meet restoration goals.

The Forest Service is also working in cooperation with the Michigan Department of Natural Resources and Environment, Consumer's Energy, The Nature Conservancy, and by extension, private landowners, to conduct coordinated management activities, particularly prescribed burning, to maximize increases in total KBB habitat creation and connectivity across different land ownerships. In addition, the Forest Service has a Karner blue butterfly Volunteer Outreach Program, which encourages private citizens to actively participate in KBB surveys and provides information about how to manage lands for savanna-dependent species.

Over the next 50 years, stands proposed for treatment under Alternatives 2 and 3 would regenerate and mature, again favoring wildlife species that prefer mature forest types. However, based upon management direction in the Forest Plan, reversion to pre-treatment conditions would be prevented as vegetation management would continue to occur within the MNF in the future. Stands restored to savanna/barrens and openings would be maintained as such before they converted to other forest types, thus continuing to provide suitable KBB habitat. Overall, the net long-term cumulative effect of the proposed restoration treatments and other protective measures and planned activities within the MNF would be beneficial to the KBB.

(3.5g) Indiana Bat

Status and Distribution

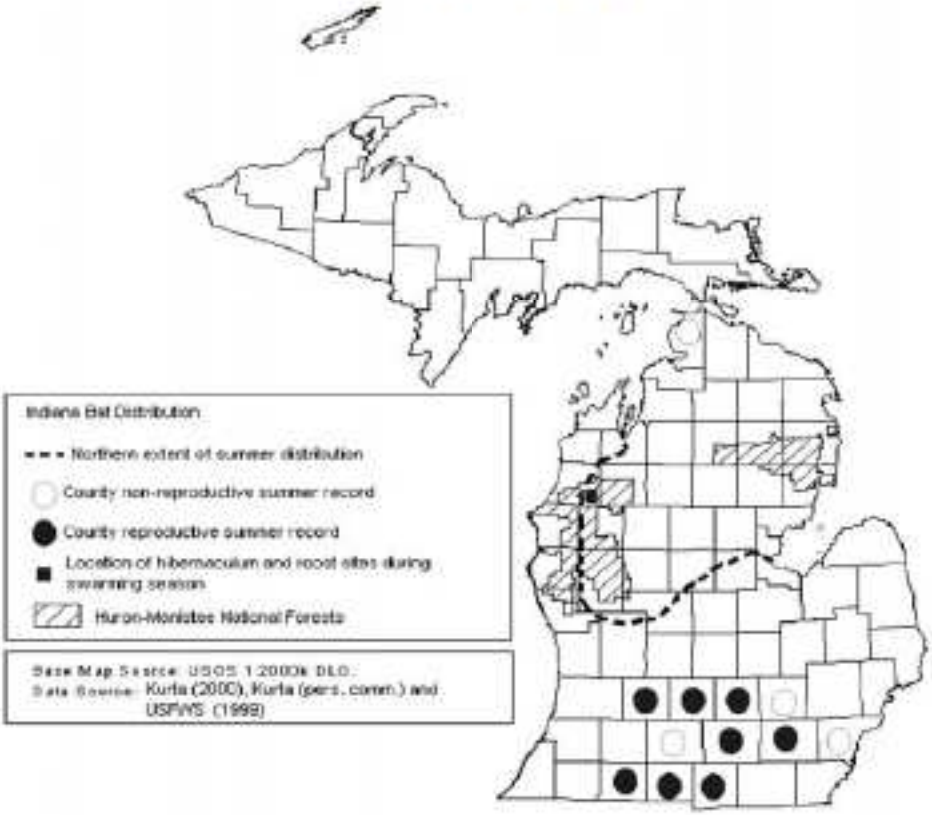
In 1967, the Indiana bat was listed federally as an Endangered species in the United States (USDI Fish and Wildlife Service 2006). A portion of the proposed activities under Alternatives 2 and 3 are within the potential breeding habitat area for Indiana bat on the HMNF (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). Indiana bats roost and form maternity colonies under loose, exfoliating bark of trees (usually dead), in live shag-bark trees, or in hollows and cavities of mature trees in floodplain and bottomland forests, riparian zones, wooded wetlands, and upland forests (MNFI 2010, USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006, USDI Fish and Wildlife Service 2007). Roost trees are typically within canopy gaps in a forest, in a fencerow, or along a wooded edge (USDI Fish and Wildlife Service 2007). In Michigan, savanna habitats adjacent to riparian corridors may have been historically important for roost sites, as the bats are thought to prefer sun-exposed trees for maximum warmth at the northern limit of their range (MNFI 2010). Indiana bats eat terrestrial and aquatic insects while foraging in forested stream corridors, upland bottomland forests, and over

impounded bodies of water at night (USDI Fish and Wildlife Service 2006). Detailed information on the ecology of Indiana bat and its status on the HMNF may be found in the Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (USDI Fish and Wildlife Service 2007), the Biological Assessment for the Huron-Manistee National Forests Environmental Impact Statement and Forest Plan (USDA Forest Service 2006a), and the Biological Opinion for the Huron-Manistee National Forests Land and Resource Management Plan (USDI Fish and Wildlife Service 2006).

Summer (May 15 through August 15) distribution of Indiana bat in Michigan occurs in the southern portion of the state and includes Barry, Branch, Calhoun, Case, Clinton, Eaton, Emmet, Hillsdale, Ingham, Jackson, Lenawee, Livingston, St. Joseph, Van Buren, Washtenaw, and Wayne Counties (Figure 3.5). Historical records from Emmet County represent the northern most summer sightings of this species in Michigan (USDA Forest Service 2006a). A small number of Indiana bats also are known to hibernate at Tippy Dam, which is located within the administrative boundary of the MNF on the Manistee River in Manistee County (USDA Forest Service 2006a). Tippy Dam is the only known Indiana bat hibernaculum in the state (USDA Forest Service 2006a), and autumn swarming and spring staging are likely restricted to this area (USDA Forest Service 2006a). The potential range of Indiana bat extends into the northwestern part of the MNF along Lake Michigan (Figure 3.5), and includes a total of 441,214 acres (USDA Forest Service 2006a). National Forest System lands within this range might provide summer habitat for maternity colonies and males (USDA Forest Service 2006a). Except for records in the Tippy Dam area, no occurrences are documented for Indiana bat on the HMNF, and the closest known summer maternity record for Indiana bat is near Vermontville, Michigan (Eaton Co.), approximately 62 miles southeast of the MNF (USDA Forest Service 2006a). No Indiana bats were found outside the Tippy Dam area on HMNF lands during surveys conducted in 1986, 1998, 1999 (USDA Forest Service 2006a). In addition, no vocalizations of Indiana bat were recorded during bat echolocation surveys conducted on HMNF lands in the summer of 2009 (USDA Forest Service 2009d).

Figure 3.5: Distribution of Indiana bat in Michigan.

(*Map from MNFI 2010*)



(*Map from USDA Forest Service 2006a*)

(3.5h) Direct Effects

Primary sources of information for this section are the Indiana bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (USDI Fish and Wildlife Service 2007), the Biological Assessment for the Huron-Manistee National Forests Environmental Impact Statement and Forest Plan

(USDA Forest Service 2006a), and the Biological Opinion for the Huron-Manistee National Forests Land and Resource Management Plan (USDI Fish and Wildlife Service 2006).

All Alternatives

No direct effects to Indiana bat would occur under Alternatives 1, 2, or 3. The Project Area is approximately fifty miles from Tippy Dam, the only known hibernaculum, and the Tippy Management Zone (swarming habitat). Therefore, no impacts to swarming bats, the hibernaculum, or wintering bats would occur. Although the Project Area is within the potential breeding (summer) range for Indiana bat, breeding Indiana bats are unlikely to occur within the Project Area. No suitable breeding habitat was found during wildlife surveys conducted in 2006, 2007, and 2009, and no vocalizations of Indiana bat were recorded during bat echolocation surveys conducted in summer 2009. Echolocation is used to distinguish different types of bat species in the field (personnel communication, Eric Britzke, U.S. Army Corps of Engineers, April 1, 2010). In addition, except for records in the Tippy Dam area, no occurrences have been documented for Indiana bat on the HMNF. We also conducted a review of GIS vegetative data layers and tree record data to identify potential breeding habitat for Indiana bat within the Project Area. Based on this review, breeding habitat for Indiana bat may occur within 5 of the stands proposed for treatment in the Project Area under Alternatives 2 and 3 (Project File - Review of Tree Record Data for Potential Indiana Bat Breeding Habitat within the SER Project Area). The likelihood of an individual bat or colony occupying one of these stands during project implementation is very low, given that, at most, approximately 65 Indiana bats are estimated to occur within the HMNF and 441,214 acres of potential Indiana bat habitat are estimated to occur within the HMNF (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006).

To further diminish the potential for direct exposure of Indiana bats to treatments proposed under Alternatives 2 and 3 during the summer maternity period, seasonal restrictions on management activities described for Indiana bat in the Forest Plan Standards and Guidelines (USDA Forest Service 2006b) would be implemented within these 5 stands (see conservation measures outlined for Indiana bat in Appendix A). Bat echolocation surveys occur annually on the Baldwin/White Cloud Ranger District. Conservation measures consistent with the Forest Plan Standards and Guidelines (USDA Forest Service 2006b) would be implemented in stands not currently listed as providing breeding Indiana bat habitat if Indiana bats are discovered during treatments or in future echolocation surveys.

(3.5i) Indirect Effects

Primary sources of information for this section are the Indiana bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (USDI Fish and Wildlife Service 2007), the Biological Assessment for the Huron-Manistee National Forests Environmental Impact Statement and Forest Plan (USDA Forest Service 2006a), and the Biological Opinion for the Huron-Manistee National Forests Land and Resource Management Plan (USDI Fish and Wildlife Service 2006).

Alternative 1

Although no Indiana bat roosting or foraging areas within the Project Area are known, Alternative 1 might change the availability of potential breeding or foraging habitat within the Project Area. Under Alternative 1, the quantity and quality of mid- to late-successional forest

habitats would likely increase within the 5 stands of potential Indiana bat habitat, and in the Project Area as a whole, due to fire suppression and natural succession. Over time, Alternative 1 may create large blocks of maturing habitat spatially distributed across the Project Area. The Indiana bat may experience an increase in available potential breeding habitat within such blocks as tree diameters and snags increase, the proportion of hardwoods increases, and canopy gaps that could increase solar exposure of roosting trees developed. However, if natural succession leads to the loss of interspersed forest openings, wooded corridors, or forested wetlands, or if forested stands develop dense understory vegetation, the availability of potential foraging and roosting habitat and/or travel corridors for Indiana bat might decline within the areas where potential breeding habitat was identified, and in the Project Area as a whole.

Alternative 1 also would fail to control Scots pine and other non-native invasive species within the areas where potential breeding habitat was identified, and in the Project Area as a whole. Scots pine may replace native forest species, including hardwoods, reducing the quantity and quality of available potential breeding habitat for the Indiana bat. NNIS may also replace native plants that provide food and cover for terrestrial and aquatic insects, reducing potential foraging habitat and prey base for the Indiana bat.

Alternative 1 would maintain current road and trail densities and, thus, human access and use in the areas where potential Indiana bat habitat has been identified. As a result, the availability of potential foraging and breeding habitat may change. These densities are higher than Forest Plan objectives for the WRSNA (USDA Forest Service 2006b). Traffic along these roads and trails may increase human activity within potential breeding habitat, which may increase the risk of potential roost trees being cut down for firewood. These activities also may damage vegetation and increase the amount of bare ground within forest openings and wooded corridors, and/or reduce water quality in forested wetlands via soil erosion or sediment delivery. Degradation of forest openings, wooded corridors, and/or forested wetlands my lead to a reduction in available prey within potential foraging habitat. However, human disturbance and associated reductions in potential breeding or foraging habitat would likely affect small acreages in localized areas within the Project Area in any given time period, allowing breeding and foraging potential in those areas that are undisturbed. Indiana bats also may benefit from forest trails and roads because they minimize understory vegetation and provide more efficient travel corridors (USDI Fish and Wildlife Service 2006). Overall, any change in the availability of potential roosting or foraging habitat under Alternative 1 would be expected to be negligible given the small number of Indiana bats estimated to occur within the HMNF, and the large forested landscape within Indiana bat range on the HMNF that has breeding and foraging potential.

Alternatives 2 and 3

Although no Indiana bat roosting or foraging areas within the Project Area are known, Alternatives 2 and 3 may change the availability of potential breeding or foraging habitat within the Project Area. Savanna creation, KBB opening restoration, red pine thinning, oak/aspen clearcuts, and prescribed burning as proposed under Alternatives 2 and 3 may result in the loss of potential roost trees for the Indiana bat in the areas where potential breeding habitat was identified. Loss of potential roost trees would be unlikely because of the Forest Plan Standards and Guidelines (see conservation measures outlined for Indiana bat in Appendix A; USDA Forest Service 2006b) requiring that management activities avoid and preserve potential roosts

and favor trees of the size, structure, and species that Indiana bats are known to frequently use. The remaining density of leave trees in these areas would be at least 9 trees per acre. These conservation measures would also be implemented during management activities within the rest of the Project Area to increase the availability of potential breeding habitat for Indiana bat. As a result, implementation of the proposed treatments may create potential roost trees, open the forest canopy, and create stands with irregular borders and openings, and subsequently increase solar exposure for potential roost trees (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). Proposed treatments may also increase the overall tree size and proportion of hardwoods in treated stands and increase the potential for large dead trees or snags suitable for roosting (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006).

Under Alternatives 2 and 3, savanna creation, KBB opening restoration, red pine thinning, oak/aspen clearcuts, and prescribed burning may also kill and/or temporarily reduce habitat quality for insects that are eaten by Indiana bat within the areas where potential breeding habitat was identified. Insect species that are vulnerable to fire may be killed during prescribed burns (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). Mechanical removal of trees may damage herbaceous vegetation and increase bare ground. Prescribed burning may temporarily increase soil erosion and sediment delivery into streams and other aquatic habitats, temporarily reducing habitat quality and quantity for terrestrial and aquatic insects eaten by Indiana bats. However, adverse effects to potential foraging habitat and the prey base of Indiana bat are unlikely because Forest Plan Standards and Guidelines (see conservation measures in Appendix A; USDA Forest Service 2006a) requiring management activities to maintain potential foraging habitat and travel corridors, and limit the potential for erosion into aquatic habitats. These conservation measures also would be implemented during management activities within the rest of the Project Area to increase availability of potential foraging habitat for Indiana bat. Implementation of proposed treatments may reduce understory vegetation within forested stands and increase the availability of wooded corridors that could be used for travel (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). This would increase foraging opportunities throughout the Project Area. Given that Indiana bats also forage within clearings with early successional vegetation (USDA Forest Service 2006a), creation and enhancement of openings and savannas/barrens may also increase the availability of native plants that provide food and cover for terrestrial insects, subsequently increasing the abundance of terrestrial insects, and hence prey availability for Indiana bat.

Strip/patch or spot application of gylphosate, triclopyr, or imazapyr to control non-native invasive species, as proposed under Alternatives 2 and 3, may also kill and/or temporarily reduce habitat quality for insects eaten by Indiana bat. Ecological risk assessments conducted for the herbicides proposed for use suggest that application of the studied herbicides at rates commonly used by the Forest Service poses little or no risk to wildlife (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). The proposed herbicides are not highly toxic to avian receptors, to insect species, to reptile species, to bat species (such as Indiana bat), or to small mammal, amphibian, and fish species that form the chief prey of carnivores such as hawks and eagles (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). The proposed herbicides are not cholinesterase inhibitors such as organophosphate or a carbamate insecticide (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. Nor are proposed herbicides chemically related to chlorinated hydrocarbon insecticides such as DDT that are highly

persistent in the environment and known to cause eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys.

Herbicide toxicity and risk data (Appendix C) for mammalian, aquatic, avian, and terrestrial wildlife species suggest glyphosate, triclopyr, and imazapyr are generally safe to mammals, birds, and other wildlife if used in accordance with the manufacturer label. The Round-Up formulation of glyphosate and butoxyethyl ester formulations of triclopyr are exceptions to this generalization due to extremely low LC_{50} values for aquatic species (Appendix C). Only formulations labeled for use in aquatic areas would be used in wetlands or riparian areas. Insects eaten by Indiana bat may be exposed to herbicides by direct contact with herbicide spray or with recently treated foliage. Insects eaten by Indiana bat also may be exposed by ingesting treated foliage, contaminated nectar, or by drinking from water sources that have received contaminated surface runoff. Risk assessments for glyphosate and triclopyr conclude that small birds and animals that consume vegetation or insects from areas treated with the maximum application rate for an extended period of time could experience adverse effects. However, this type of treatment would not occur. In addition, glyphosate, triclopyr, and imazapyr are not expected to bioaccumulate in the food chain (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). Because of the small area of treatment, insects eaten by Indiana bat would not likely come in direct contact with herbicide spray or recently treated foliage, and would not be likely to feed solely on plant parts recently treated with herbicide sprays.

Spot and strip/patch application would also reduce the likelihood that insects would come into direct contact with the herbicide spray or recently treated foliage, and minimize exposure for nearby plant species. This would further reduce opportunities for insects to feed on treated foliage or contaminated nectar. Thus, chemical removal of non-native invasive species is not expected to adversely affect potential foraging habitat or the prey base for Indiana bat by killing insects and damaging native plants that provide food and cover for insects. In addition, control of Scots pine may reduce understory vegetation and create wooded corridors and stands with irregular borders and openings, increasing the availability of travel corridors and potential breeding and foraging habitat. In the long-term, mechanical and chemical removal of non-native invasive species would likely benefit Indiana bat by improving biodiversity, and hence potential foraging habitat and prey availability within the areas where potential breeding habitat was identified, and within the Project Area as a whole.

Recreation and transportation management activities proposed under Alternatives 2 and 3 may improve the potential foraging and breeding habitat for Indiana bat. Closing Forest System roads and dispersed motorized camp sites and developing a parking area for motorized vehicles, as proposed under Alternatives 2 and 3, might reduce the risk of motorized users cutting down potential roost trees for firewood, damaging vegetation and increasing the amount of bare ground and non-native invasive species within forest openings and wooded corridors, and/or reducing water quality in forested wetlands via soil erosion or sediment delivery. Alternative 3 would reduce human use more than Alternative 2 by closing an additional 0.7 miles of Forest System roads to motorized use, with the exception of snowmobile use. In addition, Alternative 2 proposes to limit horseback riding to a 19.7 mile designated trail, develop a day-use parking area for horse rigs, and require the removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the

WRSNA, while Alternative 3 proposes to prohibit horseback riding within the WRSNA. Limiting or prohibiting horseback riding as proposed under Alternatives 2 and 3 may reduce the risk of this non-motorized use damaging or reducing the presence and productivity of forbs and shrubs, introducing and spreading non-native invasive species via manure, and increasing soil disturbance, erosion, compaction, and the amount of bare ground. Also, limiting or prohibiting horse use may reduce the risk of non-motorized users cutting down potential roost trees for firewood. Alternative 2 also would allow for watering horses with buckets hand carried to and from identified permanent water sources on National Forest System lands. Because horses would no longer be watered by walking along or in streams and other water bodies, Alternatives 2 and 3 may reduce the risk of soil erosion and sediment delivery into aquatic habitats that could reduce habitat quality for, and subsequently numbers of, aquatic insects eaten by Indiana bat. Under Alternatives 2 and 3, areas that have been degraded due to motorized and non-motorized use would likely regenerate, which may increase native plants that provide food and cover for terrestrial and aquatic insects, subsequently increasing the prey base for Indiana bat. Forest System roads proposed to be closed would be gated, but the Forest Service would continue to maintain them to provide administrative access. Thus, understory vegetation would continue to be reduced along closed roads, providing efficient potential travel corridors for Indiana bat (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). Both Alternatives 2 and 3 would meet Forest Plan management objectives for the WRSNA (USDA Forest Service 2006b).

Overall, management activities proposed under Alternatives 2 and 3 may have beneficial and negative effects to potential roosting or foraging habitat for Indiana bat. Any adverse effects would be expected to be minimal. Any change in the availability of potential roosting or foraging habitat under Alternatives 2 and 3 would be expected to be negligible, given the small number of Indiana bats estimated to occur within the HMNF, and the large forested landscape within the potential Indiana bat range on the HMNF that has roosting and foraging potential.

(3.5) Cumulative Effects

Increases in human populations and associated land development, road construction, and recreational uses are expected on private lands within the MNF. These activities could result in the permanent loss of potential Indiana bat habitat, and would likely increase the potential for human access and use near hibernaculum and roosting sites. Subsequently this will lead to increases in the level of disturbance (e.g., human activity, noise, and habitat degradation), the risk of vehicle collisions, the removal of roost trees, disruptions in the foraging behavior of Indiana bats, and the reduction of habitat quantity and quality for Indiana bat forage species. Timber harvesting, fire suppression, and the application of pesticides may adversely affect the Indiana bat on private lands within the MNF in the future. In addition, mineral developments are reasonably certain to occur in the foreseeable future within the MNF and have the potential to cumulatively affect Indiana bat. Mineral rights on federal lands are subject to an environmental analysis, review, oversight, and permit. The Forest Service might not be able to condition a permit in a manner that would preclude the development of the resource (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). In such cases, the Forest may not be able to impose a "no surface occupancy" stipulation in the permit for mineral extraction in potential Indiana bat habitat and the species may be adversely affected (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006).

While the above activities may impact non-Federal lands within the MNF, 441,214 acres of potential Indiana bat habitat occur within the boundary of the HMNF. Of these, 178,214 acres are under HMNF ownership (USDA Forest Service 2006a, USDI Fish and Wildlife Service 2006). This is a significant amount of land and should provide enough habitat for Indiana bats that might occur in the MNF (USDA Forest Service 2006a). Implementation of the objectives listed in the Indiana bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (USDI Fish and Wildlife Service 2007) and the conservation measures outlined for Indiana bat in the Forest Plan Standards and Guidelines (USDA Forest Service 2006b) are expected to produce long-term beneficial cumulative effects and improve the overall status of the species within the MNF.

(3.5k) Effects on Regional Forester's Sensitive Species and Other Wildlife

(3.5l) Wildlife Associated with Early Successional Vegetative Types

(3.5m) Direct and Indirect Effects

Alternative 1

Under Alternative 1, the quantity and quality of early successional vegetative types would continue to decline in the Project Area due to fire suppression and natural succession. As remnant openings and savannas/barrens filled in with fire-intolerant woody and shade-tolerant herbaceous species, suitable habitat favored by dusted skipper, frosted elfin, and hill-prairie spittlebug would likely become scarcer. Savanna plants such as little bluestem and wild lupine would be shaded-out or out-competed as the amount of sunlight reaching the understory vegetation becomes less. Other wildlife species preferring openings or savannas/barrens for parts of their life cycles that might experience a reduction in habitat quantity and quality under this alternative include the ruffed grouse, red-headed woodpecker, whip-poor-will, eastern box turtle, American woodcock, cottontail rabbit, snowshoe hare, fox and gray squirrel, red and gray fox, coyote, wild turkey, and white-tailed deer.

Alternative 1 would also fail to control non-native invasive plant species within remnant openings and savannas/barrens. Leafy spurge, autumn olive, honeysuckle, Canada thistle, garlic mustard, Cypress spurge, Japanese barberry, sweetclover, Scots pine, and spotted knapweed were among invasive species found during botanical surveys conducted in 2006, 2007, and 2009 within stands proposed for savanna creation or KBB opening restoration treatments. Failure to control invasive plants would not directly result in adverse impacts to local populations of wildlife. However, failure to successfully control these invasive species would allow the continued infestation and degradation of more areas of wildlife habitat within these early successional vegetative types. Aggressive invasive plants species such as leafy spurge tend to replace native plants upon which wildlife generally depend for food and cover. In general, species having relatively specific habitat requirements are more susceptible to adverse effects from the continued spread of invasive plants than habitat generalists. For example, habitat quantity and quality for frosted elfin would likely decline if autumn olive, honeysuckle, and/or leafy spurge shaded-out or out-competed wild lupine, wild indigo, or false indigo - its host plants - and other important nectar sources.

In addition, habitat quantity and quality for wildlife associated with early successional vegetative types might decline under Alternative 1 because it would maintain current road, trail, and camping densities within the Project Area. These densities are higher than Forest Plan objectives for the WRSNA (USDA Forest Service 2006b). Currently, roads, trails, and concentrated use are occurring in openings and savannas/barrens within the Project Area. In the past, dispersed camping sites have degraded habitat for listed species dependent on openings and savanna/barrens such as KBB (USDI Fish and Wildlife Service 2006). In addition, horseback riding occurs on Forest System roads throughout the Project Area, and cross-county travel is permitted for horseback riding, except where posted signs exclude this form of recreation. Some roads and trails within the Project Area provide habitat (i.e., wild lupine and other nectar plants growing along roadsides, or road-rut ponds providing watering areas) and/or dispersal corridors for species associated with early successional vegetative types. Vehicle use, dispersed camping, horseback riding, and foot traffic along roads and trails and within adjacent openings, may increase the level of disturbance (e.g., human activity, noise, and habitat degradation); damage host plants and other plant species used for food or cover; temporarily displace, alter movement, or disrupt normal behavior of wildlife; and increase the risk of vehicle collisions, visitors directly harming, harassing, or killing wildlife, illegal collection (including poaching), and wildfire. In addition, traffic along roads and trails might increase the risk of off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles), cross-country horseback riding, and dispersed camping, which might adversely affect wildlife habitat via soil erosion and compaction, increases in bare ground, reduction in nectar plants, and increases in non-native invasive species. Thus, maintaining current levels of access and use would likely increase the risk of mortality and reduce habitat quantity and quality for wildlife associated with early successional vegetative types.

As habitat quality and quantity decrease for wildlife associated with early successional vegetative types under Alternative 1, occurrences of these species within the Project Area would likely decline. Surviving populations would become even more isolated and disconnected, and thus subject to a higher risk of extirpation from catastrophic events. Overall, Alternative 1 is likely to have adverse direct and indirect effects on RFSS associated with early successional vegetative types.

Alternatives 2 and 3

KBB opening restoration, savanna creation, red pine thinning, oak/aspen clearcuts, and prescribed burning, proposed under Alternatives 2 and 3, may kill or temporarily displace small numbers of dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, red-headed woodpecker, whip-poor-will, ruffed grouse, and other wildlife associated with early successional vegetative types within the Project Area. Eastern box turtle, dusted skipper, frosted elfin, and hill-prairie spittlebug have limited mobility and would likely not escape the proposed management activities. While eastern box turtles and some adult stages of dusted skipper, frosted elfin, and hill-prairie spittlebug may be able to move out of treated areas, the eggs and larvae of these species are immobile and thus are particularly vulnerable and likely to be crushed during mechanical treatments such as brush hogging or discing, burned during prescribed burning, or trampled during hand cutting. In addition, the proposed treatments may also affect the movement patterns and nests of red-headed woodpecker, whip-poor-will, ruffed grouse, and American woodcock. Ground disturbances within openings may also destroy eastern box turtle nests, reducing reproductive success. Management activities may

disrupt the normal behavior of wildlife, which could limit the use of foraging, nesting, roosting, or hibernation sites and potentially affect productivity. Vehicle use and foot traffic along roads and within openings during management activities may temporarily increase the level of disturbance (e.g., human activity, noise, and habitat degradation); damage plant species used for food or cover; temporarily displace, alter movement, or disrupt normal behavior of wildlife; and increase the risk of vehicle collisions, and visitors directly harming, harassing, or killing wildlife. In addition, amphibian populations would likely decrease within two years of regenerating a forested area due to leaf and moisture loss. This would likely rebound to normal levels after 20 years (Ash 1997).

Breeding birds, small mammals, and less mobile species, such as reptiles and invertebrates, are most likely to be directly affected in these operations due to the use of heavy equipment and the activities associated with prescribed burning. Operations during the breeding season would have the potential to cause disturbance, destroy or damage nests and dens, or kill/injure small young and less mobile species. Management activities conducted between September and March could directly impact wildlife use in the fall and small numbers of wintering animals, but would largely protect nesting birds, hibernating reptiles, and other breeding wildlife. For example, because the eastern box turtle occupies hibernacula underground during the winter, management activities are more likely to have a direct effect on the eastern box turtle between early spring and late fall when they are most active (Hyde 1999). The season, intensity, and frequency of management activities, particularly prescribed burns, also could have detrimental effects on dusted skipper, frosted elfin, and hill-prairie spittlebug through the killing of eggs, larvae, or adults. For example, operations during the larval and flight periods have the greatest potential of causing disturbance, damaging host plants, and killing or disrupting the behavior of dusted skipper, frosted elfin, and hill-prairie spittlebug.

Implementation of the conservation measures listed for KBB in Appendix A within the 73 openings proposed for KBB opening restoration would minimize the potential for adverse direct effects on invertebrates, nesting birds, and mating reptiles. For example, excluding prescribed burning, all management activities proposed under KBB opening restoration would be prohibited between March 15 and August 15. In addition, only a portion of openings proposed for KBB opening restoration would be treated each season, which would reduce take of invertebrates and facilitate recolonization of recently treated portions. Potential adverse effects would be reduced further with the implementation of the conservation measures outlined in the Programmatic Biological Evaluation for the Huron-Manistee National Forests for duster skipper, eastern box turtle, red-headed woodpecker, and whip-poor-will (USDA Forest Service 2005) in areas where RFSS associated with early successional vegetative types are documented or found. In addition, the locations of known nests, roosts, or burrows of RFSS would be flagged or marked, and management activities would be performed carefully to avoid physical injury to nests or burrows and less mobile RFSS. If other sensitive wildlife species associated with early successional vegetative types are found during project activities, appropriate protection measures would be implemented to reduce potential adverse effects.

Under Alternatives 2 and 3, strip/patch or spot application of gylphosate, triclopyr, or imazapyr is proposed to control non-native invasive species and persistent woody vegetation. Ecological risk assessments conducted for glyphosate, triclopyr, and imazapyr suggest that use at rates commonly used by the Forest Service poses little or no risk to wildlife (USDA Forest

Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). The proposed herbicides are not highly toxic to avian receptors (e.g., red-headed woodpecker, whip-poor-will), to insect species (e.g., dusted skipper, frosted elfin, hill-prairie spittlebug), to reptile species (e.g., eastern box turtle), or to the small mammal, amphibian, and fish species that form the chief prey of carnivores such as red-shouldered hawks, northern goshawks, and bald eagles (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). Proposed herbicides are not cholinesterase inhibitors such as organophosphate or a carbamate insecticide (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. Nor are the proposed herbicides chemically related to chlorinated hydrocarbon insecticides such as DDT that are highly persistent in the environment and known for causing eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys. Herbicide toxicity and risk data (Appendix C) for mammalian, aquatic, avian, and terrestrial wildlife species suggest glyphosate, triclopyr, and imazapyr are generally safe to mammals, birds, and other wildlife if used in accordance with the manufacturer label.

Wildlife associated with early successional vegetative types could be exposed to herbicides by direct contact with herbicide spray or with recently treated foliage. Oral exposure also could occur by ingesting contaminated nectar or by drinking from water sources that have received contaminated surface runoff. However, because strip/patch or spot application of herbicide would be used to treat small areas, wildlife associated with early successional vegetative types would not be likely to come into direct contact with herbicide spray or recently treated foliage, and nectivores, insectivores, and fruitivores such as dusted skipper, hill-prairie spittlebug, and eastern box turtle are not likely to feed solely on plant parts recently treated with herbicide sprays. The risk assessments for glyphosate and triclopyr conclude that small birds and animals that consume vegetation or insects from areas treated with the maximum application rate for an extended period of time could experience adverse effects. However, this type of treatment would not occur. In addition, glyphosate, triclopyr, and imazapyr are not expected to bioaccumulate in the food chain (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). If work is conducted in areas containing RPSS, locations of nests or other immobile wildlife features would be prominently marked whenever possible and operators would be trained to visually recognize the protected animals.

Vegetative management proposed under Alternatives 2 and 3 would likely have a greater effect on local populations of dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, red-headed woodpecker, whip-poor-will, ruffed grouse, and other wildlife associated with early successional vegetative types through habitat change. For example, red-headed woodpeckers and other wildlife species dependent on hard mast production (e.g., wild turkey, squirrels, and white-tailed deer) would likely experience a reduction in food resources due to savanna creation treatments. Management activities also might damage vegetation and increase the amount of bare ground within treated openings, temporarily decreasing cover and the abundance of native grasses, herbs, wildflowers, and fruit-bearing shrubs that serve as host plants and/or food. In addition, without sufficient knowledge of what plant species are present on a given site and their response to different management activities, implementation of proposed treatments might increase undesired plant species. For example, fire may either increase the abundance of invasive species, such as spotted knapweed, and/or native species, such as Pennsylvania sedge, that compete with wild lupine and nectar plants. Disturbance from restoration activities also might create conditions favorable for establishment of non-

native invasive species, such as spotted knapweed and St. John's wort. Proposed herbicide treatments under Alternatives 2 and 3 would minimize occurrence of non-natives and favor more desirable native nectar species. Effects of herbicides on the growth and flowering of wild lupine and other nectar plant species varies, and at times might result in a temporary reduction in habitat quantity and quality for dusted skipper, hill-prairie spittlebug, and frosted elfin and other nectivores and herbivores. Such reductions are expected to be minimal with the seeding/planting of wild lupine and other native nectar plants. Controlling non-native invasive shrubs (e.g., autumn olive and honeysuckle) that bear fruit and serve as nectar sources for bees and other insects would likely reduce available habitat and food for wildlife associated with early successional vegetative types such as dusted skipper and eastern box turtle. Overall, potential adverse indirect effects to wildlife associated with early successional vegetative types are expected to be minimal with the implementation of the conservation measures listed for KBB in Appendix A within KBB opening restoration and savanna creation treatment areas, and the conservation measures outlined in the Programmatic Biological Evaluation for the Huron-Manistee National Forests for the duster skipper, eastern box turtle, red-headed woodpecker, and whip-poor-will (USDA Forest Service 2005) in areas where these RFSS are documented or found.

Under Alternatives 2 and 3, savanna creation and KBB opening restoration also may improve habitat for herbivores occurring within the Project Area. In particular, deer may experience an increase in habitat quantity and quality, potentially causing localized increases in deer numbers and increased herbivory on wild lupine and other nectar plants within savanna creation and KBB opening restoration areas. Herbivory on wild lupine and other nectar plants may destroy eggs and larvae of RFSS invertebrates such as frosted elfin, and reduce productivity in the long-term by limiting the growth of native nectar species. Such effects have been noted for KBB. High deer densities have been reported to kill KBB, reduce lupine populations, and potentially reduce KBB reproduction by limiting lupine growth (Schweitzer 1994, USDI Fish and Wildlife Service 2006). Schweitzer (1994) recommends that deer populations be managed to levels where no more than 15 percent of lupine flowers are consumed. However, management of deer populations is outside Forest Service jurisdiction and authority.

Much of the habitat change expected under the Proposed Action would likely have beneficial indirect effects to dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, red-headed woodpecker, whip-poor-will, ruffed grouse, and other wildlife associated with early successional vegetative types. Proposed vegetative management activities would increase the quantity and quality of openland habitats (e.g., openings, savanna/barrens) and early successional aspen forest. Oak/aspen clearcuts would regenerate aspen and provide the age-class diversity required for whip-poor-will and ruffed grouse on approximately 23 acres under Alternatives 2 and 3. Savanna creation and KBB opening restoration activities, proposed under Alternatives 2 and 3, would create up to 3,061 acres of openings and savannas/barrens. This acreage would contribute to the Forest Plan's management goals for restoring savannas/barrens and upland openings (USDA Forest Service 2006b). KBB opening restoration and savanna creation activities would increase habitat quantity and quality for wildlife associated with early successional vegetative types by: maintaining open areas; providing a diversity of foraging habitats; promoting nectaring sources from shrubs and wildflowers, larval host plants including wild lupine, and savanna plant species such as warm season grasses

including bluestem; and providing other features important to wildlife, such as sunning areas, roosting sites, and nesting areas.

As openland habitats with bluestem, wild lupine, wild indigo, false indigo, and other nectar plants and warm season grasses increase, suitable habitat, and subsequently occurrences, of dusted skipper, hill-prairie spittlebug, and frosted elfin would likely increase. The red-headed woodpecker, eastern box turtle, and whip-poor-will have diverse habitat requirements that include openland habitats, and consequently would also benefit from savanna creation and KBB opening restoration activities. Red-headed woodpeckers require open woodlands with mast crop abundance and nesting cavities in live trees, dead stubs, snags, utility poles, or fence posts (USDA Forest Service 2005, NatureServe 2010). Eastern box turtles occur in upland forested habitats with sandy soils, thickets, old fields, pastures, marshes, vegetated dunes, and bog edges near or adjacent to a source of water, and require access to nearby sandy, open areas for nesting (Hyde 1999, USDA Forest Service 2005, NatureServe 2010). Whip-poor-wills occur in open coniferous, deciduous, and mixed woodlands with well spaced trees and a low canopy, abundant shade, nearby open areas, and sparse ground cover (USDA Forest Service 2005, NatureServe 2010). Because savanna creation and KBB opening restoration activities would create a heterogeneous habitat mosaic that provides subhabitat variation in tree canopy and shrub cover, plant community composition, thermal environment, topography, and soil moisture, these treatments would provide the range of habitat conditions required by red-headed woodpecker, eastern box turtle, and whip-poor-will, in addition to those required by the dusted skipper, hill-prairie spittlebug, and frosted elfin. Thus, oak/aspen clearcuts, KBB opening restoration, and savanna creation would lead to an increase in suitable habitat, which would likely increase the occurrence of dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, whip-poor-will, red-headed woodpecker, and ruffed grouse within the Project Area.

Other wildlife species that may experience an increase in habitat quantity and quality, and subsequently population numbers, following treatments to enhance early successional vegetative types within the Project Area include, but are not limited to: American woodcock, cottontail rabbit, snowshoe hare, fox and gray squirrel, red and gray fox, coyote, wild turkey, and white-tailed deer. Overall, vegetative management activities proposed under Alternatives 2 and 3 are expected to have primarily beneficial direct and indirect effects on wildlife associated with early successional vegetative types within the Project Area, and any adverse direct and indirect effects are expected to be minimal.

Off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles), cross-country travel via foot or horseback, and dispersed camping may increase within areas proposed for savanna creation and KBB opening restoration under Alternatives 2 and 3. Increased recreational use might reduce the quantity and quality of early successional habitat by:

1. Increasing the level of disturbance (e.g., human activity, noise, and habitat degradation);
2. Damaging plant species used for host plants, food, or cover;
3. Increasing the risk of vehicle collisions, and visitors directly harming, harassing, or killing wildlife;
4. Temporarily displacing, altering movement, or disrupting normal behavior of wildlife (e.g., interfering with dispersal or mating activities);

5. Increasing soil disturbance, erosion, compaction, and the amount of bare ground;
6. Spreading and increasing non-native invasive plant species; and/or
7. Increasing the risk of illegal collection (including poaching), and wildfires.

The potential for adverse effects should be minimized with the installation of signs explaining the benefits of restoring native plant communities and requesting recreationists to stay on designated roads and trails. Implementing mitigation techniques would limit public access to managed savannas and openings. These would include barrier posts or piling brush around the perimeter of treatment areas.

Recreation management activities proposed under Alternatives 2 and 3 would have primarily beneficial effects to local populations of wildlife associated with early successional vegetative types within the Project Area. Closing Forest System roads, reducing the number of motorized-dependent camping sites, and developing a parking area for motorized vehicles might reduce the risk of motorized users:

1. Damaging or disturbing plant species used for food, cover, and/or hosts (e.g., trampling, removing, or otherwise damaging wild lupine or other important nectar plants);
2. Temporarily displacing, altering movement, or disrupting normal behavior of wildlife (e.g., interfering with dispersal or mating activities); and/or
3. Resulting in vehicle collisions, visitors directly harming, harassing, or killing wildlife, illegal collection (including poaching), and wildfires.

Reduced traffic along roads would also likely decrease the risk of off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles) and cross-country travel, which might adversely affect wildlife habitat via soil erosion and compaction, increases in bare ground, reduction in native nectar plants and warm season grasses, and increases in non-native invasive species. Roads and trails that border savanna creation and KBB opening restoration treatments would likely experience an increase in nectar plant availability, increasing the quality and quantity of dispersal corridors for invertebrates such as dusted skipper, hill-prairie spittlebug, and frosted elfin within the Project Area. Human use and its associated impacts may adversely affect wildlife associated with early successional vegetative types where county roads and Forest System roads remain open to motorized use within openland habitats. Potential adverse effects from Forest System roads that would remain open within KBB opening restoration and savanna creation treatment areas would be minimized with the implementation of conservation measures outlined for KBB occupied and potential unoccupied habitat in Appendix A.

Signs and barriers would be installed along all Forest System roads that would still occur within KBB opening restoration areas (i.e., occupied KBB habitat) to prevent off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles) and dispersed camping. If Forest System roads and their associated uses are found to adversely impact KBB or its habitat, they would be relocated or decommissioned. Signs explaining the benefits of restoring native plant communities and requesting recreationists to stay on designated roads and trails would be installed along all Forest System roads that would still occur within savanna creation areas (i.e., potential unoccupied KBB habitat). If damage from motorized users is noted within potential unoccupied KBB habitat, mitigation techniques would be implemented to limit public access such as barrier

posts or piling brush around the perimeter of treatment areas. Potential adverse effects from county roads that would remain open to motorized use within KBB opening restoration areas (i.e., occupied KBB habitat) and savanna creation areas (i.e., potential unoccupied KBB habitat) also would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A. Alternative 3 would reduce human access and use more than Alternative 2 by closing an additional 0.7 miles of Forest System roads to motorized use, with the exception of snowmobile use.

Alternatives 2 and 3 also would also limit horseback riding within the WRSNA. Currently, horseback riding occurs on Forest System roads throughout the Project Area, and cross-country travel is permitted for horseback riding, except where posted signs exclude this form of recreation. Alternative 2 proposes to limit horseback riding to a 19.7 mile designated trail, develop a day-use parking area for horse rigs, and require the removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the White River Semi-Primitive Non-Motorized Area (WRSNA), while Alternative 3 proposes to prohibit horseback riding within the WRSNA. Limiting or prohibiting horseback riding may reduce the risk of this non-motorized use: trampling wildlife; temporarily displacing, altering movement, or disrupting the normal behavior of wildlife (i.e., interfere with dispersal or mating activities); damaging or reducing the presence and productivity of wild lupine and other savanna nectar plants, grasses, and shrubs; introducing and spreading non-native invasive species; and/or increasing soil disturbance, erosion, compaction, and the amount of bare ground. Requiring the removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the WRSNA would also likely reduce the risk of introducing and spreading non-native invasive species within the Project Area. Allowing for watering horses with buckets at identified permanent water sources would not be expected to affect wildlife associated with early successional vegetative types, as proposed watering locations would not occur within openlands and early successional forests.

Horseback riding and its associated impacts may adversely affect wildlife associated with early successional vegetative types where county roads, Forest System roads, and National Forest System lands remain open to this non-motorized use within early successional habitats. Potential adverse effects from cross-country travel and horseback riding along Forest System roads within early successional habitats would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A. Signs and barriers would be installed explaining the benefits of restoring native plant communities and requesting recreationists to stay on Forest System roads within KBB opening restoration areas (i.e., occupied KBB habitat). If damage from horseback riding is noted within KBB opening restoration areas (i.e., occupied KBB habitat), Forest System roads providing access to damaged areas would be relocated or decommissioned. Signs also would be installed on Forest System roads within savanna creation areas (i.e., unoccupied KBB habitat). If damage from horseback riding is noted within savanna creation areas (i.e., unoccupied KBB habitat), barriers would be installed to ensure the public stays on Forest System roads. Potential adverse effects from county roads that would remain open to horseback riding within KBB opening restoration areas (i.e., occupied KBB habitat) and savanna creation areas (i.e., potential unoccupied KBB habitat) also would be minimized with the implementation of conservation measures outlined for KBB habitat in Appendix A.

Overall, recreation management activities proposed under Alternatives 2 and 3 would likely decrease the risk of mortality and improve habitat quantity and quality for dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, red-headed woodpecker, whip-poor-will, ruffed grouse, and other wildlife associated with early successional vegetative types within the Project Area. Alternative 3 would reduce potential adverse effects of recreational use to wildlife associated with early successional vegetative types more than Alternative 2. Both Alternatives would meet Forest Plan management objectives for the WRSNA (USDA Forest Service 2006b).

(3.5n) Cumulative Effects

Increases in human populations and associated land development, road construction, and recreational uses are expected on private lands within the MNF. These activities would likely result in the degradation and permanent loss of habitat for wildlife associated with early successional habitats, and directly impact individuals of these species by:

- Increasing habitat fragmentation, level of disturbance (e.g., human activity, noise, and habitat degradation), amount of bare ground, and soil erosion, and introducing non-native invasive plant species;
- Increasing predation and/or competition by increasing wildlife populations associated with human residential areas such as raccoons, opossums, and skunks;
- Damaging host plants (e.g., wild lupine, bluestem) and other important plant species that provide food (e.g., foliage, nectar, or fruit) and/or cover, as well as other required habitat elements such as nesting, roosting, and/or hibernation sites;
- Temporarily displacing, altering movement, or disrupting normal behavior of wildlife associated with early successional habitats; and
- Increasing the risk of vehicle collisions, wildfires, visitors directly harming, harassing, or killing individual wildlife, illegal collection (including poaching), dispersed camping, and cross-country travel.

Additional actions performed on private lands that may adversely affect wildlife associated with early successional habitats in the future within the MNF are fire suppression, mowing and grazing, off-road vehicle use (i.e., all terrain vehicles, dirt bikes, snowmobiles), application of pesticides, and timber harvest. In addition, mineral developments are reasonably certain to occur in the foreseeable future within the MNF and have the potential to cumulatively affect wildlife associated with early successional habitats. Although land development activities may increase non-forested areas on private lands within the MNF, the habitat conditions preferred by wildlife associated with openlands that might occur within the Project Area are not likely to increase proportionately. For example, there is unlikely to be a proportionate increase in the host and nectar plants preferred by Regional Forester Sensitive Insect Species (e.g., dusted skipper, hill-prairie spittlebug, frosted elfin), or in habitat requirements such as nesting, roosting, and hibernation sites utilized by RFSS such as the red-headed woodpecker and the eastern box turtle.

In addition, newly created non-forested areas on private lands within the MNF are unlikely to provide the diverse habitat mosaics preferred by RFSS such as the red-headed woodpecker, whip-poor-will, and eastern box turtle. The creation of non-forested areas on private lands within the MNF also is reducing the acreage of early successional aspen stands. Private forested

lands are expected to shift towards a mix of young and mature oak and lowland hardwoods, replacing other forested types including aspen. As a consequence, there will likely be a decline in suitable habitat for ruffed grouse and whip-poor-will. Overall, habitat quantity and quality for wildlife associated with early successional vegetative types, and subsequent occurrences of these species, would likely decline on private lands within the MNF. With the increasing development and fragmentation of private lands, suitable habitat for wildlife associated with early successional vegetative types on National Forest System lands within the MNF is likely to become more important in the future.

The Forest Plan emphasizes management for oak barrens/savanna ecosystems, particularly for KBB conservation, and directs the restoration and maintenance of 20,300 acres of savanna/barrens within designated KBB population management areas and essential KBB habitat within the HMNF (USDA Forest Service 2006b). The 519 acres of KBB opening restoration and 2,542 acres of savanna creation proposed would help achieve this goal. Implementation of the conservation measures noted in Appendix A should minimize potential adverse effects to RFSS species associated with early successional vegetative types and their habitats on National Forest System lands within the Project Area. Although increases in human populations and associated land uses and developments are expected within the MNF in the future, beneficial effects of Forest Service projects such as the Proposed Action should help to mitigate potential negative effects of activities on private lands.

In addition, 365 acres of savanna creation is planned for KBB within the White River Metapopulation Area under the Savanna/Barrens Restoration Project (USDA Forest Service 2008), and 431 acres of opening restoration for KBB within the White River and Otto Metapopulation Areas is occurring under the Karner Blue Butterfly Habitat Restoration Project (USDA Forest Service 2009c). The actions that are proposed under Alternatives 2 and 3 complement these two restoration efforts by expanding the acreage to be treated for savanna creation and opening restoration, and increasing the number of treatment techniques that can be used to meet restoration goals. The Forest Service also is working in cooperation with the Michigan Department of Natural Resources and Environment, Consumer's Energy, The Nature Conservancy, and by extension, private landowners, to conduct coordinated management activities, particularly prescribed burning, to maximize increases in total KBB habitat creation and connectivity across different land ownerships. In addition, the Forest Service has a Karner blue butterfly Volunteer Outreach Program, which encourages private citizens to actively participate in KBB surveys and provides information about how to manage lands for savanna-dependent species. Overall, the net long-term cumulative effect of proposed opening restoration and savanna creation treatments and other protective measures and planned activities within the MNF would be beneficial to wildlife associated with early successional vegetative types.

(3.5o) Wildlife Associated with Mid- to Late-Successional Forest Types

(3.5p) Direct and Indirect Effects

Alternative 1

Under Alternative 1, the quantity and quality of mid- to late-successional forest habitats would continue to increase in the Project Area due to fire suppression and natural succession. Over time, Alternative 1 would create large blocks of maturing habitat spatially distributed across the

Project Area. The quality of forested stands within such blocks may increase for northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, eastern box turtle, black bear, and other wildlife species associated with mid- to late-successional forest types (e.g., pileated woodpecker, brilliant scarlet tanager, red and gray fox, coyote, black-throated green warbler, gray and fox squirrel, white-tailed deer, bobcat, and northern flying squirrel). Tree diameters, the proportion of hardwoods, large woody debris, snags, and tree cavities would all increase, and canopy gaps would develop. As these mature forest characteristics develop, northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, and prothonotary warblers may experience an increase in suitable nesting and foraging habitat.

In particular, an increase in mature forest near rivers, streams, lakes, ponds, swamps, and wetlands may increase the availability of nesting, roosting, and perching sites for bald eagle, red-shouldered hawk, cerulean warbler, Louisiana waterthrush, and prothonotary warbler. Increases in mature forest with canopy gaps near a source of water may also increase the foraging and nesting habitat for the eastern box turtle. In addition, greater understory growth and woody debris might increase the abundance and availability of potential denning sites and prey species for black bear. However, if succession leads to the loss of interspersed forest openings, uplands, and/or wetlands, the availability of suitable nesting and/or foraging habitat for wildlife associated with mid- to late-successional forest types may decline. For example, the loss of intermittent openings may reduce the availability of unshaded nesting sites adjacent to upland forests, which are critical for successful eastern box turtle reproduction (Hyde 1999).

Alternative 1 would also fail to control Scots pine and other non-native invasive species in the Project Area, reducing the quantity and quality of breeding and foraging habitat for wildlife species associated with mid- to late-successional forest habitats. Scots pine may replace native forest species, including hardwoods, reducing the quantity and quality of suitable nesting habitat for mid- to late-successional avian species. In addition, non-native invasive plant species might replace the native plants that provide food and cover for small mammals, birds, and terrestrial and aquatic insects. This would reduce the suitable foraging habitat and prey base for the RFSS associated with this habitat type. Reductions in native plants (such as berry producing species) and invertebrates resulting from the spread of invasive species may also reduce suitable foraging habitat and prey base for the eastern box turtle and the black bear. However, this potential adverse effect would likely be minimal due to the small acreages affected.

In addition, habitat quantity and quality for wildlife associated with mid- to late-successional forest types may decline under Alternative 1 because it would maintain current road and trail densities within the Project Area. These densities are higher than Forest Plan objectives for the WRSNA (USDA Forest Service 2006b). Traffic along these roads and trails may increase the level of disturbance (e.g., human activity, noise, and habitat degradation), and increase the risk of nest trees being cut down for firewood, ground nests of eastern box turtles being destroyed, vehicle collisions with wildlife, illegal collection (including poaching), wildfires, dispersed camping, and cross-country travel. Such disturbance may cause northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, prothonotary warblers, and other birds associated with forested habitats to abandon their nest sites, and disrupt the normal nesting and foraging behavior of wildlife associated with mid- to late-

successional forest types, limiting use of nest sites and foraging areas and potentially affecting productivity.

These activities may also damage vegetation and increase the amount of bare ground within forest openings and upland areas, and/or reduce water quality in rivers, streams, lakes, ponds, swamps, and wetlands via soil erosion or sediment delivery. Degradation of forest openings, uplands, and aquatic habitats might lead to a reduction in available foraging and/or nesting habitat for northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, eastern box turtle, black bear, and other wildlife associated with mid- to late-successional forest types. However, human disturbance and associated reductions in nesting or foraging habitat would likely affect small acreages in localized areas within the Project Area in any given time period, allowing nesting and foraging potential in those areas that are undisturbed. Overall, Alternative 1 is expected to have primarily beneficial direct and indirect effects on wildlife associated with mid- to late-successional forest habitats, and any adverse direct and indirect effects are expected to be minimal.

Alternatives 2 and 3

Savanna creation, KBB opening restoration, oak/aspen clearcuts, red pine thinning, and prescribed burning, proposed under Alternatives 2 and 3, may kill or temporarily displace small numbers of wildlife species associated with mid- to late-successional forest types within the Project Area. Traffic associated with implementation may temporarily increase the risk of mortality due to vehicle collisions. Vegetative management activities and vehicle and foot traffic associated with implementation may also temporarily increase the level of disturbance (e.g., human activity, noise, and habitat degradation) near active nests, potentially resulting in nest abandonment and/or the removal of nest sites. Severe nest site disturbance, such as road building or timber harvest activity, can cause abandonment of nests, particularly during incubation of the eggs (USDA Forest Service 2002a, Roberson et al. 2003). Timber harvest activity that occurs during the non-nesting season when the birds are not really attached to the site doesn't result in abandonment if the site is not severely changed, such as by a clearcut (USDA Forest Service 2002a, Roberson, et. al. 2003).

In addition, ground disturbance within forest openings may reduce the reproductive success of eastern box turtles if nest sites are destroyed. Management activities may also remove denning sites for black bears, and/or temporarily displace, alter movement, or disturb northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, prothonotary warblers, eastern box turtles, and black bears by limiting the use of potential breeding and foraging habitat, and potentially affecting productivity. Management activities conducted between September and March would largely protect northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, and prothonotary warblers, and eastern box turtles within the Project Area, as this time period is outside of the breeding and active periods of these RPSS.

Potential adverse direct effects that Alternatives 2 and 3 might have on the RPSS associated with mid- to late-successional forest types would be minimized with the implementation of the following conservation measures found in the following:

- The Northern Goshawk (*Accipiter gentilis atricapillus*) in the Western Great Lakes Region: A Technical Conservation Assessment (Roberson, et. al. 2003);
- Draft Western Great Lakes Northern Goshawk (*Accipiter gentilis atricapillus*) Conservation Assessment (USDA Forest Service 2007c);
- Management Recommendations for the Northern Goshawk on the Huron-Manistee National Forests (USDA Forest Service 1993);
- Conservation Assessment for Red-Shouldered Hawk (*Buteo lineatus*) (USDA Forest Service 2002a);
- Bald Eagle Management Plan for the Huron-Manistee National Forests (USDA Forest Service 2006c);
- Northern States Bald Eagle Recovery Plan (USDI Fish and Wildlife Service 1983);
- Conservation Assessment for Cerulean Warbler (*Dendroica cerulea*) (USDA Forest Service 2003c);
- Conservation measures for species viability for the cerulean warbler, northern goshawk, red-shouldered hawk, and eastern box turtle outlined in the Programmatic Biological Evaluation for the Huron-Manistee National Forest (USDA Forest Service 2005); and
- Forest Plan Standards and Guidelines (USDA Forest Service 2006b).

These measures would ensure that the timing and spatial pattern of management activities avoid known nesting locations during the breeding season. For example, management activities would not occur within 400' of an occupied cerulean warbler nest tree during the breeding season (USDA Forest Service 2005). In addition, management activities would be prohibited within primary buffers (660') of active northern goshawk and red-shouldered hawk nests, and known northern goshawk and red-shouldered hawk nests would be protected during project implementation. Implementation of the Standards and Guidelines for Watershed Management described in the Forest Plan (USDA Forest Service 2006b: pages II-17 – II-22) would further reduce the potential for adverse direct effects on bald eagle, red-shouldered hawk, cerulean warbler, Louisiana waterthrush, and prothonotary warbler.

For example, the potential for direct effects would be reduced somewhat by the Guideline stating that equipment should not be operated within the Streamside Management Zone when soils are saturated or when rutting is likely to occur (USDA Forest Service 2006b). This would limit activities to periods when the soils in the riparian corridor were frozen, such as winter, which would be outside of the nesting season for these RFSS. To further reduce the potential for direct effects, the locations of known nests, roosts, and dens of rare or sensitive wildlife species would be flagged or marked, and management activities would be performed carefully to avoid physical injury to such structures and less mobile wildlife such as eastern box turtle. If other sensitive wildlife species associated with mid- to late-successional forest types are found during project activities, appropriate protection measures would be implemented to reduce potential adverse direct effects.

Under Alternatives 2 and 3, strip/patch or spot application of gylphosate, triclopyr, or imazapyr would be used to control non-native invasive species and persistent woody vegetation. Wildlife associated with mid- to late-successional vegetative types may be exposed to these herbicides:

1. By direct contact with recently treated foliage;

2. By consuming prey items that have come in direct contact with herbicide spray, recently treated foliage, or consumed parts of treated plants;
3. By consuming treated foliage; or
4. By drinking from water sources that have received contaminated surface runoff.

Ecological risk assessments conducted for glyphosate, triclopyr, and imazapyr suggest that rates commonly used by the Forest Service pose little or no risk to wildlife (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). The proposed herbicides are not highly toxic to avian receptors (e.g., cerulean warblers, northern goshawks, red-shouldered hawks, Louisiana waterthrush, prothonotary warbler) to insect species (e.g., Karner blue butterfly), to reptilian species (e.g., eastern box turtle), or to the small mammal, amphibian, and fish species that form the chief prey of carnivores such as red-shouldered hawks, northern goshawks, and bald eagles (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). Proposed herbicides are not cholinesterase inhibitors such as organophosphate or a carbamate insecticide (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. Nor are the proposed herbicides chemically related to the chlorinated hydrocarbon insecticides such as DDT that are highly persistent in the environment and known for causing eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys.

Herbicide toxicity and risk data (Appendix C) for mammalian, aquatic, avian, and terrestrial wildlife species suggest glyphosate, triclopyr, and imazapyr are generally safe to mammals, birds, and other wildlife if used in accordance with the manufacturer label. The Roundup formulation of glyphosate and butoxyethyl ester formulations of triclopyr are exceptions to this generalization, due to the extremely low LC_{50} values for aquatic species (Appendix C). However, only formulations labeled for use in aquatic areas would be used within 100 feet of wetlands or riparian areas. Risk assessments for glyphosate and triclopyr conclude that small birds and animals that consume vegetation or insects from areas treated with the maximum application rate for an extended period of time could experience adverse effects. However, this type of treatment would not occur. Because spot and strip/patch application would be used to treat small areas within the Project Area, it would be unlikely that wildlife associated with mid- to late-successional forest types would come in direct contact with recently treated foliage, or would feed solely on prey or plants that have been exposed to herbicide sprays. In addition, consumption of exposed prey would likely have a minimal effect on these wildlife species given that glyphosate, triclopyr, and imazapyr are not expected to bioaccumulate in the food chain (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b).

Management activities under Alternatives 2 and 3 would likely have a greater effect on local populations of northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, prothonotary warblers, eastern box turtles, black bears, and other wildlife associated with mid- to late-successional forest types through habitat change. Savanna creation, KBB opening restoration, oak/aspen clearcuts, red pine thinning, and prescribed burning would reduce the amount of mid- to late-successional forest habitat within the Project Area. Approximately 3,000 acres of mature forest would be converted to openland habitats (e.g., openings and savannas/barrens) and early successional forest. As a consequence, species dependent on hard mast production (e.g., red-headed woodpecker, wild turkey, squirrels, white-tail deer) may experience a reduction in food availability, which may subsequently lead

to a reduction in prey availability and abundance for foraging northern goshawks, red-shouldered hawks, bald eagles, and black bears. While savanna creation and KBB opening restoration may reduce hard mast production over the long term, oak/aspen clearcuts, Scots pine removal, and red pine thinning would likely reduce hard mast production over the short term, as stands receiving these treatments would regenerate to mature forests in the future.

In addition, the proposed management activities may damage vegetation and increase the amount of bare ground within forest openings and upland areas. This may lead to a temporary reduction in native plants that provide food and cover for small mammals, birds, and terrestrial and aquatic insects and a short-term decline in suitable foraging habitat and prey base for northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, and prothonotary warbler. Reductions in native plants (such as berry producing species) and invertebrates may also temporarily reduce suitable foraging habitat and prey base for eastern box turtle and black bear. However, these potential short term effects would be expected to be minimal, given that human disturbance and associated reductions in foraging habitat would potentially affect only small acreages in localized areas within the Project Area in any given time period. This would allow foraging potential in those areas that remain undisturbed.

Management activities would also increase forest fragmentation and the amount of edge, which may reduce the nesting success of forest-interior bird species, such as the northern goshawk and red-shouldered hawk, due to higher rates of predation, higher rates of parasitism, and reductions in pairing success. Fragmentation of forest stands and the creation of larger openings favor the immigration of nest competitors and predators such as the red-tailed hawk and great-horned owl (Cooper 1999a). These species can either displace northern goshawk or red-shouldered hawk nesting pairs or directly depredate young and/or adults from a nest site (Cooper 1999a). Other effects related to fragmentation include: increased parasitism by brown-headed cowbirds, increased nest competition with species such as the house wren, and/or increased predation from species such as raccoons. These may reduce the reproductive success of cerulean warblers, Louisiana waterthrushes, and prothonotary warblers (Gibson 2007a, Gibson 2007b, Hyde et al. 2000).

Forestry practices such as clearcutting produce only temporary edges and fragmentation. For example, aspen regenerates quickly and within approximately 10 years, oak/aspen clearcuts would have closed canopies, and in about 20+ years, tree heights approach the original stands. Thus, any adverse effects from oak/aspen clearcuts, red pine thinning, and Scots pine removal would likely be short term for species favoring forest interior conditions. However, savanna creation and KBB opening restoration would likely reduce habitat quantity and quality for these interior-dependent species over the long term. Because a relatively small percentage (18%) of the Project Area would be affected by vegetative management activities, reductions in foraging and breeding habitat would not likely decrease the overall numbers of northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, prothonotary warblers, eastern box turtles, black bears, and other wildlife associated with mid- to late-successional forest types within the Project Area.

The proposed vegetative management activities under Alternatives 2 and 3 may also have beneficial indirect effects to the foraging and breeding habitat of wildlife associated with mid- to late-successional forest types. Management for early successional vegetative types may

increase the quantity and quality of interspersed forest openings and uplands, increasing the availability of native grasses, forbs, and shrubs that provide food and cover for small mammals, birds, and terrestrial insects, subsequently increasing the abundance and diversity of forage and prey species. As a consequence, suitable foraging habitat and prey base for wildlife associated with mid- to late-successional forest types may increase within the Project Area. An increase in opens areas within upland forests near waterbodies would also likely increase the availability of suitable nesting areas for eastern box turtle. Scots pine removal would control a non-native invasive species and replace it with native vegetation (i.e., aspen and oak). The newly established native species might increase species richness and diversity, and subsequently increase the quantity and quality of foraging and/or breeding habitat for wildlife species associated with mid- to late-successional forest habitats. Prescribed burning may also indirectly benefit these wildlife species by:

1. Reducing the potential for wildfire;
2. Damaging or killing trees, contributing to the production of snags, down wood, and potential perch trees; and
3. By maintaining forest openings that provide nesting or foraging areas for wildlife such as eastern box turtles and northern goshawks.

Overall, vegetative management activities under Alternatives 2 and 3 would have both beneficial and negative direct and indirect effects on wildlife associated with mid- to late-successional forest types within the Project Area. Adverse effects would be expected to be minimal.

Recreation management activities proposed under Alternatives 2 and 3 would have primarily beneficial effects to local populations of wildlife associated with mid- to late-successional forest types within the Project Area. Closing Forest System roads, reducing the number of motorized-dependent camping sites, and developing a parking area for motorized vehicles may decrease levels of disturbance (e.g., human activity, noise, and habitat degradation) and reduce the risk of motorized users:

1. Damaging or destroying nest trees, ground nests, and roost and perch trees;
2. Causing disturbance that leads to nest abandonment;
3. Temporarily displacing, altering movement, or disrupting the normal behavior of wildlife (e.g., interfering with nesting or foraging activities); and/or
4. Temporarily reducing suitable foraging habitat and prey base by damaging vegetation and increasing the amount of bare ground and non-native invasive species within forest openings and upland areas.

Reducing motorized use may also reduce the risk of vehicle collisions with wildlife, visitors directly harming, harassing, or killing wildlife, illegal collection (including poaching), and wildfires. Alternative 3 would reduce human use more than Alternative 2 by closing an additional 0.7 miles of Forest System roads to motorized use, with the exception of snowmobile use.

In addition, Alternative 2 proposes to limit horseback riding to a 19.7 mile designated trail, develop a day-use parking area for horse rigs, and require the removal of horse manure, feed,

and hay at the designated day-use parking area and at designated camping areas within the WRSNA. Alternative 3 proposes to prohibit horseback riding within the WRSNA. Limiting or prohibiting horseback riding as proposed under Alternatives 2 and 3 may reduce the risk of this non-motorized use damaging or reducing the presence and productivity of native forbs and shrubs used for food or cover by wildlife and/or their forage species, introducing and spreading non-native invasive species via manure, and/or increasing soil disturbance, erosion, compaction, and the amount of bare ground. Also, limiting or prohibiting horse use may reduce the risk of non-motorized users damaging or destroying ground nests or cutting down nest, roost, or perch trees for firewood, causing disturbance that leads to nest abandonment, and/or temporarily displacing, altering movement, or disrupting the normal behavior of wildlife (i.e., interfere with dispersal or mating activities).

In addition, requiring the removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the WRSNA may reduce the risk of introducing and spreading non-native invasive species within the Project Area. Alternative 2 would also allow for the watering of horses with buckets hand-carried to and from identified permanent water sources on National Forest System lands. Because horses would no longer be watered by walking along or in streams and other water bodies, Alternatives 2 and 3 may reduce the risk of soil erosion and sediment delivery into rivers, streams, lakes, ponds, swamps, and wetlands. Under Alternatives 2 and 3, areas that have been degraded due to motorized and non-motorized use would likely regenerate, which may increase the native plants that provide food and cover for small mammals, birds, and terrestrial and aquatic insects, subsequently increasing suitable foraging habitat and prey base for wildlife associated with mid- to late-successional forest types.

Overall, recreation management activities proposed under Alternatives 2 and 3 would likely decrease the risk of mortality and improve habitat quantity and quality for northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, eastern box turtle, black bears, and other wildlife associated with mid- to late-successional forest types within the Project Area. Alternative 3 would reduce potential adverse effects of recreational use to these wildlife species more than Alternative 2. Both Alternatives would meet Forest Plan management objectives for the WRSNA (USDA Forest Service 2006b).

(3.5q) Cumulative Effects

Increases in human populations and associated land development, road construction, and recreational uses are expected on private lands within the MNF. In addition, a change in land use from larger forested parcels to smaller parcels with more development is occurring on private ownerships and is expected to continue into the foreseeable future. These activities would likely increase the potential for human access and use near northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, eastern box turtle, and black bear nesting, roosting, perching, foraging, and denning sites. Subsequently this will lead to increased levels of disturbance, habitat fragmentation, the risk of vehicle collisions with wildlife, illegal poaching and collection, wildfires, dispersed camping, and cross-country travel. Such disturbance might damage nesting, roosting, perching, or denning sites and/or cause such sites to be abandoned.

In addition, the increase in the number of residences and associated developments within the MNF has likely increased wildlife populations associated with human residential areas such as raccoons, opossums, and skunks, which may predate active nest sites. Increases in human development, access, and use also might remove potential nesting, roosting, perching, or denning sites and/or temporarily species associate with mid- to late- successional habitat. Human disturbance may also disrupt the normal foraging behavior of wildlife, limiting use of foraging areas and potentially affecting productivity. In addition, increases in human development, access, and use might decrease the quantity and quality of forest openings, upland areas, and aquatic habitats (e.g., rivers, streams, lakes, ponds, swamps, and wetlands), potentially decreasing the abundance and diversity of forage and prey species, and subsequently reducing foraging habitat and the prey base. Thus, increases in human populations and associated developments and uses could result in the permanent loss and degradation of breeding and foraging habitat on private lands within the MNF. This magnifies the importance of National Forest System lands to these species. Timber harvest, fire suppression, and the application of pesticides are also activities that might adversely affect wildlife species associated with mid- to late-successional vegetative types on private lands within the MNF in the future. In addition, mineral developments are reasonably certain to occur in the foreseeable future within the MNF and have the potential to cumulatively affect wildlife associated with mid- to late-successional forest types.

The amount of mid- to late-successional forest habitat is expected to be reduced under the Forest Plan's new management direction in localized areas (USDA Forest Service 2006b). Management for early successional vegetative types would decrease the amount of mature forest habitat available for northern goshawks, red-shouldered hawks, bald eagles, cerulean warblers, Louisiana waterthrushes, prothonotary warblers, eastern box turtles, and black bears, and increase the effects of forest fragmentation (such as increased competition from red-tailed hawks or house wrens, predation from raccoons, or nest parasitism by brown-headed cowbirds). However, other management directives delineated in the Forest Plan protect mid- to late-seral stages of forest vegetation.

Semiprimitive, wild and scenic river designations, rare plant areas, and candidate RNA's would protect hardwood forests, reducing habitat fragmentation. In these areas, there would be fewer roads, less vegetation manipulation, and reduced disturbance from recreational activities. The old growth designation would provide planned old growth in the northern hardwood and long-rotation oak type. In addition, management of the hardwood forest types would continue to provide a stable or increasing amount of mature habitat for wildlife associated with mid- to late-successional forest types, and would provide adequate amounts of regenerating hardwood types for prey habitat. The amount of pine thinnings, mature oak and aspen forest regeneration, and dead tree salvage treatments is projected to remain at 1979 – 2005 levels. Thus, overall, the Forest Plan's management directives would provide large blocks of maturing habitat spatially interspersed with early successional vegetative types across the MNF (providing habitat for early- and late-successional wildlife species). As a result, the amount of mid- to late-successional forest habitat is expected to remain stable at a broad scale across the MNF. In addition, in the long term, the overall quality of mid- to late-successional forest habitat would increase as stands matured and tree diameters increased, large woody debris and snags increased, and canopy gaps developed.

Implementation of the conservation measures noted in Appendix A will protect RFSS species associated with mid- to late-successional forest types and their habitats on National Forest System lands within the MNF from adverse affects that might potentially result from the Proposed Action. Therefore, the effects of the Proposed Action are expected to be local, and would not be expected to affect the viability of northern goshawk, red-shouldered hawk, bald eagle, cerulean warbler, Louisiana waterthrush, prothonotary warbler, and eastern box turtle within the MNF. Overall, populations of these RFSS are expected to remain stable or increase within the MNF.

(3.5r) Wildlife Associated with Streams, Creeks, Lakes, and Wetlands

(3.5s) Direct and Indirect Effects

Alternative 1

Under Alternative 1, the Forest Service would continue to manage for late seral stages along wetlands and riparian areas. As a consequence, the quantity and quality of forested habitat adjacent to water bodies would increase over time. Tree diameters and dead and down woody debris would increase and canopy gaps would develop. Increases in mature forest with canopy gaps near rivers, streams, creeks, lakes, and wetlands may increase nesting and/or foraging habitat for Blanding's turtle, wood turtle, and other water-dependent wildlife species (e.g., great blue heron, wood duck, mallard, black duck, Canada goose, and beaver). If succession leads to the loss of interspersed forest openings, uplands, and/or wetlands, then the availability of suitable nesting and/or foraging habitat for these species might decline. This alternative would also fail to control Scots pine and other non-native invasive species in the Project Area that may replace native forest species that provide food and/or cover for wildlife associated with aquatic habitats (e.g., streams, creeks, lakes, and wetlands). However, this potential adverse effect would likely be minimal due to the small acreages affected.

In addition, Alternative 1 would maintain current road and trail densities within the Project Area. These densities are higher than Forest Plan objectives for the WRSNA (USDA Forest Service 2006b). Traffic along these roads and trails may increase the level of disturbance (e.g., human activity, noise, and habitat degradation), the risk of vehicle collisions with wildlife, illegal collection (including poaching), wildfires, dispersed camping, and cross-country travel. Road and trail traffic may also:

1. Temporarily displace, alter movement, or disrupt the normal behavior of wildlife;
2. Lead to an increase in mammalian predators associated with human activities;
3. Destroy the ground nests of Blanding's turtles or wood turtles;
4. Damage or cause the abandonment of great blue heron, wood duck, mallard, black duck, or Canada goose roost or nest sites;
5. Damage or destroy hibernacula and forage plants; and/or
6. Reduce water quality in rivers, streams, creeks, lakes, and wetlands via increased erosion or sediment delivery.

Habitat fragmentation resulting from the road and trail system also might reduce wildlife productivity due to increases in nest predation near habitat edges. Thus, maintaining current levels of access and use might increase the risk of mortality, reduce available breeding and

foraging habitat, and limit the use of nesting and foraging areas for Blanding's turtles, wood turtles, and other wildlife associated with aquatic habitats. This would potentially affect the survivorship and reproductive success of these species. Overall, Alternative 1 is expected to have adverse direct effects, and beneficial and adverse indirect effects on wildlife associated with aquatic habitats.

Alternatives 2 and 3

Alternatives 2 and 3 may kill or temporarily displace small numbers of wood turtles, Blanding's turtles, and other wildlife associated with aquatic habitats (e.g., great blue heron, wood duck, mallard, black duck, Canada goose, and beaver) if management activities occur near rivers, streams, creeks, lakes, or wetlands. Savanna creation, KBB opening restoration, oak/aspen clearcuts, red pine thinning, prescribed burning, and vehicle and foot traffic associated with implementation may increase the risk of mortality due to vehicle collisions with wildlife, and temporarily increase the level of disturbance (e.g., human activity, noise, and habitat degradation) near nest, roost, or hibernation sites. This would potentially result in the abandonment and/or removal of such sites. Management activities also might temporarily disturb Blanding's turtles, wood turtles, and other wildlife associated with aquatic habitats searching for sunning, foraging, roosting, nesting, and hibernation sites, limiting the use of breeding and/or foraging habitat and potentially affecting productivity.

Water-orientated wildlife species that have limited mobility and/or are breeding, such as Blanding's turtle and wood turtle, are most likely to be directly affected in these operations due to heavy equipment use and prescribed burning. Management activities are more likely to have an adverse direct effect on the wood turtle and Blanding's turtle if implemented near aquatic habitats between late spring to early fall when these species increase their use of adjacent uplands and forests for foraging, mating, and/or nesting (Lee 1999a, Lee 1999b). Between late fall and early spring, direct effects on these RFSS are expected to be insignificant as Blanding's turtles and wood turtles spend the majority of their time in aquatic habitats (Lee 1999a, Lee 1999b). This would largely protect them from any direct impacts. Direct effects on black-crowned night-heron also are expected to be minimal during this time period as wintering birds can readily move among roost sites.

To minimize the potential adverse direct effects that Alternatives 2 and 3 might have on Blanding's turtle, wood turtle, and other wildlife associated with this habitat type, conservation measures from the following sources would be incorporated in areas where these species are documented or found during project activities:

- The R9 Species Conservation Assessment for Wood Turtle – *Glyptemys insculpta* (USDA Forest Service 2004b);
- The Conservation Assessment for Blanding's Turtle (*Emydoidea blandingii*) (USDA Forest Service 2002b);
- The conservation measures for species viability for wood turtle and Blanding's turtle outlined in the Programmatic Biological Evaluation for the Huron-Manistee National Forest (USDA Forest Service 2005); and
- The Standards and Guidelines for Watershed Management described in the Forest Plan (USDA Forest Service 2006b: pages II-17 – II-22).

For example, the potential for direct effects would be reduced somewhat by the Guideline stating that equipment should not be operated within the Streamside Management Zone when soils are saturated or when rutting is likely to occur (USDA Forest Service 2006b). This would limit site preparation activities to periods when the soils in the riparian corridor were frozen, such as winter, which would correspond to the inactive period of reptilian species and would be outside the nesting season of waterfowl and shorebirds. In addition, the locations of nests or burrows of rare or sensitive wildlife species, such as the wood turtle and Blanding's turtle, would be flagged or marked, and management activities would be performed carefully to avoid physical injury to nests, burrows, and less mobile wildlife. If other sensitive wildlife species associated with aquatic habitats are found during project activities, appropriate protection measures would be implemented to reduce potential adverse effects.

Alternatives 2 and 3 propose strip/patch or spot application of gylphosate, triclopyr, or imazapyr to control non-native invasive species and persistent woody vegetation. Wildlife associated with aquatic habitats might be exposed to these herbicides by: direct contact with recently treated foliage; by consuming treated foliage or prey items that have come in direct contact with herbicide spray, recently treated foliage, or consumed parts of treated plants; or by drinking from or swimming in water sources that have received contaminated surface runoff. However, ecological risk assessments conducted for glyphosate, triclopyr, and imazapyr suggest that rates commonly used by the Forest Service pose little or no risk to wildlife (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b). The proposed herbicides are not highly toxic to avian receptors such as red-shouldered hawks or prothonotary warblers, to insect species such as Karner blue butterflies, to reptilian species such as Blanding's turtle or wood turtle, or to small mammal, amphibian, and fish species that form the chief prey of carnivores such as bald eagles (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b).

The proposed herbicides are not cholinesterase inhibitors such as organophosphate or a carbamate insecticide (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. Nor are the proposed herbicides chemically related to the chlorinated hydrocarbon insecticides such as DDT that are highly persistent in the environment and known for causing eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys. Herbicide toxicity and risk data (Appendix C) for mammalian, aquatic, avian, and terrestrial wildlife species suggest that glyphosate, triclopyr, and imazapyr are generally safe to mammals, birds, and other wildlife if used in accordance with the manufacturer label. The Roundup formulation of glyphosate and butoxyethyl ester formulations of triclopyr are exceptions to this generalization due to the extremely low LC_{50} values for aquatic species (Appendix C). However, only formulations labeled for use in aquatic areas would be used within 100 ft of wetlands or riparian areas.

Risk assessments for glyphosate and triclopyr conclude that small birds and animals that consume vegetation or insects from areas treated with the maximum application rate for an extended period of time could experience adverse effects. However, this type of treatment would not occur. Because spot and strip/patch application would be used to treat small areas within the Project Area, it would be unlikely that wildlife associated with aquatic habitats would come in direct contact with recently treated foliage, would feed solely on prey or plants that have been exposed to herbicide sprays, or would be exposed to contaminated water

sources. In addition, consumption of exposed prey would likely have a minimal effect on these species given that glyphosate, triclopyr, and imazapyr are not expected to bioaccumulate in the food chain (USDA Forest Service 2003a, USDA Forest Service 2003b, USDA Forest Service 2004b).

Management activities under Alternatives 2 and 3 would likely have a greater effect on local populations of Blanding's turtle, wood turtle, and other wildlife associated with aquatic habitats through habitat change. Savanna creation, KBB opening restoration, oak/aspen clearcuts, red pine thinning, prescribed burning, and vehicle and foot traffic associated with implementation may damage vegetation and increase the amount of bare ground within treated openings and uplands near rivers, streams, creeks, lakes, and wetlands, temporarily decreasing cover and the abundance of important forage species, such as herbs, wildflowers, and berry producing shrubs. Increased habitat fragmentation near water bodies also may result from project implementation, potentially reducing productivity due to increased nest predation near habitat edges. Management activities, particularly prescribed burning, may also reduce dead and down woody debris that provides structure for thermal regulation and protection from predators. In addition to increasing the quantity and quality of forest openings and uplands, prescribed burning might indirectly benefit Blanding's turtle and wood turtle by reducing the potential for wildfire and damaging or killing trees.

The proposed vegetative management activities under Alternatives 2 and 3 may also have beneficial indirect effects to the foraging and breeding habitat of Blanding's turtles, wood turtles, and other water-oriented wildlife species. Management for early successional vegetative types may increase the quantity and quality of interspersed forest openings and uplands, increasing the availability of sunning and nesting areas, and increasing native grasses, forbs, and berry producing shrubs (i.e., increasing the abundance and diversity of forage species). Control of Scots pine and other non-native invasive species may also increase native species richness and diversity, increasing available for food and cover for wildlife associated with aquatic habitats. Overall, vegetative management activities under Alternatives 2 and 3 are expected to have adverse and beneficial direct and indirect effects on wildlife associated with aquatic habitats within the Project Area, and any adverse effects are expected to be minimal.

Recreation management activities proposed under Alternatives 2 and 3 would have primarily beneficial effects to local populations of Blanding's turtle, wood turtle, and other wildlife associated with aquatic habitats within the Project Area. Closing Forest System roads, reducing the number of motorized-dependent camping sites, and developing a parking area for motorized vehicles may decrease levels of disturbance (e.g., human activity, noise, and habitat degradation), and reduce the effects of fragmentation (e.g., nest predation near habitat edges). Reducing motorized use may also reduce the risk of motorized users:

1. Destroying or causing the abandonment of nests, roosts, or hibernation sites;
2. Temporarily displacing, altering movement, or disrupting the normal behavior of wildlife (e.g., interfering with nesting, foraging, sunning, roosting, or hibernation activities); and/or
3. Temporarily reducing suitable foraging habitat and prey base by damaging vegetation and increasing the amount of bare ground and non-native invasive species within forest openings and upland areas.

In addition, reducing motorized use may also reduce the risk of vehicle collisions with wildlife, visitors directly harming, harassing, or killing wildlife, illegal collection (including poaching), and wildfires. Alternative 3 would reduce motorized access more than Alternative 2 by closing an additional 0.7 miles of Forest System roads, with the exception of snowmobile use.

Currently, horseback riding occurs on Forest System roads throughout the Project Area, and cross-country travel is permitted for horseback riding, except where posted signs exclude this form of recreation. Limiting or prohibiting horseback riding as proposed under Alternatives 2 and 3 may reduce the damage to the presence and productivity of native grasses, forbs, and berry producing shrubs used for forage; introduction and spread of non-native invasive species via manure; and soil disturbance, erosion, compaction, and the amount of bare ground. Also, limiting or prohibiting horse use may reduce the risk of non-motorized users damaging or destroying ground nests of Blanding's turtles and wood turtles and/or temporarily displacing, altering movement, or disrupting the normal behavior of wildlife. In addition, requiring removal of horse manure, feed, and hay at the designated day-use parking area and at designated camping areas within the WRSNA may reduce the risk of introducing and spreading non-native invasive species within the Project Area.

Access to available water bodies for watering horses currently is unregulated within the Project Area. Alternative 2 would allow for watering horses with buckets hand carried to and from identified permanent water sources on National Forest System lands. Because horses would no longer be watered by walking along or in streams and other water bodies, Alternatives 2 and 3 may reduce the risk of soil erosion and sediment delivery into rivers, streams, creeks, lakes, and wetlands that could reduce habitat quality and quantity for water-oriented wildlife species. Under Alternatives 2 and 3, areas that have been degraded due to motorized and non-motorized use would likely regenerate, which might increase foraging, breeding, and hibernating habitat for Blanding's turtle, wood turtle, and other wildlife species associated with aquatic habitats.

Overall, recreation management activities proposed under Alternatives 2 and 3 would likely decrease the risk of mortality and improve habitat quantity and quality for wildlife associated with aquatic habitats within the Project Area. Alternative 3 would reduce potential adverse effects of recreational use to these species more than Alternative 2. Both Alternatives would meet Forest Plan management objectives for the WRSNA (USDA Forest Service 2006b).

(3.5t) Cumulative Effects

Increases in human populations and associated land development, road construction, and recreational uses are expected on private lands within the MNF. These activities would likely increase the potential for human access and use within or adjacent to aquatic habitats used by wood turtles, Blanding's turtles, and other wildlife associated with aquatic habitats (e.g., great blue heron, wood duck, mallard, black duck, Canada goose, and beaver). Increased human access and use could increase the level of disturbance (e.g., human activity, noise, and habitat degradation), increase the risk of vehicle collisions with wildlife, illegal collection (including poaching), wildfires, dispersed camping, and cross-country-travel, disrupt the movements and normal behavior of individual animals, and/or increase predation by increasing mammalian

predator populations that are associated with human activities (e.g., raccoon, opossum, skunks). Development of residences near water bodies could also reduce habitat quantity and quality through the actual destruction of nesting sites, hibernacula, cover, and/or important plant species that provide food (e.g., foliage, fruit). Such developments could also increase habitat fragmentation and reduce water quality in streams and lakes via increased soil erosion or sediment delivery. Timber harvest, fire suppression, mowing, off-road vehicle (i.e., all terrain vehicles, dirt bikes, snowmobiles) and motorboat use, and the application of pesticides are also activities that might adversely affect wildlife associated with aquatic habitats on private lands. In addition, mineral developments are reasonably certain to occur in the foreseeable future within the MNF and have the potential to cumulatively affect wildlife associated with aquatic habitats. Overall, habitat quantity and quality for wildlife associated with aquatic habitats, and subsequent occurrences of these species, would likely decline on private lands within the MNF. With increasing development and fragmentation of private lands, suitable habitat for wildlife associated with aquatic habitats on National Forest System lands within the MNF is likely to become more important in the future.

Under the direction of the Forest Plan (USDA Forest Service 2006b), management actions to improve watershed condition would continue elsewhere within the MNF, focusing on erosion control, upgrading road stream crossings, lowering road densities, improving in-stream and lake habitat, and maintaining riparian buffer zones. As the forest continues to mature, more large woody debris (LWD) input into streams and lakes would occur. LWD can protect stream banks from erosion, provide habitat for aquatic insects, provide cover for fish, and provide habitat diversity. Although management for early successional vegetative types, as directed by the Forest Plan (USDA Forest Service 2006b), would decrease the amount of mature forest and lead to more open space within the watersheds located within the MNF, there should be a minimal effect on runoff and flow regimes because all of the sixth level watersheds will still have more than 33% of their area in a mature forest (>20 year age class) condition. While increases in human populations and associated land uses and development are expected within the MNF in the future, the positive effects of planned watershed management activities on the Forest should mitigate the negative effects of activities on private lands. Overall, there should be an improvement in water quality, aquatic habitat, and watershed health within the watersheds located within the MNF.

Implementation of the conservation measures noted in Appendix A should protect RFSS associated with aquatic habitats on National Forest System lands within the MNF from adverse affects that might potentially result from the Proposed Action. Therefore, the effects of the management activities under Alternatives 2 and 3 are expected to be local, and would not be expected to affect the viability of the wood turtle or Blanding's turtle within the MNF.

(3.5u) Determination of Effects for Endangered, Threatened, and Sensitive Wildlife Species

A Biological Assessment and Biological Evaluation was prepared for the Savanna Ecosystem Restoration Project (see Project Record) that documented the determinations of effects of Savanna Ecosystem Restoration Project activities on federally-listed or proposed-to-be-listed Endangered or Threatened species and critical habitat, and on Regional Forester's Sensitive Species (RFSS) by each alternative. Sixteen wildlife species that may be present or have habitat within the Project Area were analyzed in these documents including: Karner blue butterfly, Indiana bat, dusted skipper, hill-prairie spittlebug, frosted elfin, eastern box turtle, red-headed

woodpecker, whip-poor-will, bald eagle, cerulean warbler, Louisiana waterthrush, northern goshawk, prothonotary warbler, red-shouldered hawk, Blanding's turtle, and wood turtle. The determinations are listed below in Table 3.19. The determinations were made contingent on implementation of the conservation measures listed in Appendix A. The conservation measures would be implemented with the action alternatives. The ruffed grouse was not included in the Biological Assessment and Biological Evaluation because it is only a Terrestrial Management Indicator Species, not a federally-listed Endangered or Threatened Species or RFSS. However, the determinations of effects on this species also are included in Table 3.19.

Table 3.19: Determination of Effects for Endangered, Threatened, and Sensitive Wildlife Species that Might Occur within the Savanna Ecosystem Restoration Project Area

Common Name	Habitat Ecology	Status	Alternative 1	Alternative 2	Alternative 3
Karner Blue Butterfly *(Lycaeides melissa samuelis (Nabokov) [or Plebejus melissa (Edwards 1873)])*	Savanna/barrens habitats with abundant wild lupine (the sole food source for the caterpillar), abundant adult nectar sources, warm season grasses for basking and roosting, and ants to protect larvae from parasites and predators.	E+MIS	May Affect, Likely to Adversely Affect	May Affect, Likely to Adversely Affect	May Affect, Likely to Adversely Affect
Indiana Bat *(Myotis sodalist)*	Roost and form maternity colonies under loose, exfoliating bark of trees (usually dead), in live shag-bark trees, or in hollows and cavities of mature trees in floodplain and bottomland forests, riparian zones, wooded wetlands, and upland forests.	E	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Ruffed Grouse *(Bonasa umbellus)*	Mixed deciduous and conifer forests (especially early seral stages dominated by aspen) and oak-savanna woodland, with forests 5-25 years old providing brood habitat and cover, and older forest age classes providing nesting habitat and winter food sources.	MIS	MINT	MINT	MINT
Dusted Skipper *(Atrytonopsis hianna)*	Typically found in localized colonies in bluestem grassland, barrens, prairie, or other openland habitats where little bluestem - its larval food plant - occurs [larvae may also feed on big blue stem].	RFSS	MINT	MINT	MINT
Hill-Prairie Spittlebug *(Lepyronia gibbosa)*	Prairie bowls in mesic dry sand prairie zones with abundant forbs.	RFSS	MINT	MINT	MINT
Frosted Elfin *(Incisalia irus)*	Grassy openings or burn scars in barrens and savannas with abundant wild lupine, false indigo, or wild indigo – its host plants - and other nectar sources.	RFSS	MINT	MINT	MINT
Eastern Box Turtle *(Terrapene carolina carolina)*	Forested habitats (coniferous, deciduous and mixed) with sandy soils and openings near a source of water, and in adjacent fields, woodlands, and marshes.	RFSS	MINT	MINT	MINT

Table 3.19 (continued): Determination of Effects for Endangered, Threatened, and Sensitive Wildlife Species that Might Occur within the Savanna Ecosystem Restoration Project Area

Common Name	Habitat Ecology	Status	Alternative 1	Alternative 2	Alternative 3
Red-Headed Woodpecker *(Melanerpes erythrocephalus)*	Mature open woodlands, open deciduous or mixed forest habitats, or savanna-like forest habitat with nearby openings, snags and mast crop abundance.	RFSS	MINT	MINT	MINT
Whip-poor-will *(Caprimulgus vociferous)*	Open coniferous, deciduous, and mixed woodlands with well spaced trees and a low canopy, abundant shade, nearby open areas, and sparse ground cover.	RFSS	MINT	MINT	MINT
Bald Eagle *(Haliaeetus leucocephalus)*	Nests in tall, dominant deciduous or coniferous trees, and sometimes cliffs, along or close to major rivers, large lakes, deep marshes, or clusters of small lakes and streams where adequate prey is available and human disturbance is minimal to none.	RFSS	MINT	MINT	MINT
Cerulean Warbler *(Dendroica cerulean)*	Nests and perches in the canopy of large, tall, trees that occur in large tracts of mature deciduous forest, bottomlands, floodplains, and lowland hardwoods, with an open understory, close to rivers and the Lake Michigan shoreline.	RFSS	MINT	MINT	MINT
Louisiana Waterthrush *(Seiurus motacilla)*	Nests on the ground along clear, fast-flowing streams and rivers in contiguous, deciduous, and often hilly forests containing moderate to sparse undergrowth.	RFSS	MINT	MINT	MINT
Northern Goshawk *(Accipiter gentilis)*	Nests in large tracts of mature pine, hardwood, or mixed forests with an intermediate amount of canopy closure, large deciduous trees for nesting, small forest openings for foraging, and an open understory.	RFSS	MINT	MINT	MINT
Prothonotary Warbler *(Protonotaria citrea)*	Nests in tree cavities of dead snags and live trees within riparian corridors, wooded swamps, floodplain forests, and bottomland hardwood forests with dense underbrush near or over water.	RFSS	MINT	MINT	MINT
Red-Shouldered Hawk *(Buteo lineatus)*	Nests in large tracts of mature deciduous or mixed forests with closed canopies, large deciduous trees for nesting, nearby wetland and upland habitats interspersed for foraging, and variable amounts of understory vegetation.	RFSS	MINT	MINT	MINT
Blanding's turtle *(Emydoidea blandingii)*	Lakes, ponds, marshes, and creeks with abundant aquatic vegetation and soft bottoms, and in the spring and summer, occupies adjacent open, sunny, upland areas with sandy soils.	RFSS	MINT	MINT	MINT

Table 3.19 (continued): Determination of Effects for Endangered, Threatened, and Sensitive Wildlife Species that Might Occur within the Savanna Ecosystem Restoration Project Area

Common Name	Habitat Ecology	Status	Alternative 1	Alternative 2	Alternative 3
Wood Turtle *(Glyptemys insculpta)*	Streams and adjacent forested riparian and upland floodplain areas with numerous openings and a dense mixture of low herbs and shrubs, and in the summer may roam widely overland occupying nearby terrestrial habitats including fields, woodlands, and marshes.	RFSS	MINT	MINT	MINT
Status E = federally endangered T = federally threatened MIS = Terrestrial Management Indicator Species RFSS = Regional Forester Sensitive Species		Determinations MINT = May impact individuals or sub-populations, but not likely to cause a trend towards federal listing or loss of viability.			

(3.6) Fisheries and Watershed

(3.6a) Existing Condition and Resource-Specific Information

Watershed Condition

The rivers and tributaries within the Project Area are typically ground water fed with stable flow, high water quality, and carry a relatively high sediment load. This sediment loading is due, in part, to the inherently fine soils and surface alluvium across the landscape that are sensitive to management. Visual evidence of historic human use (i.e. timber harvesting and agriculture) is present in the form of old log rollways, drained wetland areas, and a highly-developed transportation network. The combination of these has influenced stream bank integrity, channel geomorphology, sediment budget, and the flood hydrograph such that channel function is impaired in most systems.

The watersheds in the Project Area exist within a fragmented landscape, in regard to both hydrology (dams, increasing road density, loss of wetlands, etc.,) and forest cover. Most forms of hydrologic fragmentation tend to narrow and heighten the flood hydrograph, increasing the risk of damage to stream bank integrity, channel morphology, aquatic habitat, and facilities located in the riparian/floodplain zone. Dams are one form of fragmentation that generally reduce the risk of flood impacts, but do have considerable impacts upon sediment regimes and biological processes, particularly species migration/population connectivity, timing of water delivery, and water temperature.

Forest cover fragmentation occurs over space and time as a result of natural processes (wildfire, wind events, other natural disturbances), but can be augmented when human activities (timber harvest, agricultural and urban land clearing, road building, etc.) increase the quantity and rate of fragmentation. Typically, mature forested stands protect watershed integrity, whereas increasing proportions of open land cover and immature stands (<15 years old) have negative impacts on watershed function and biological function. Such impacts particularly affect the rate of runoff, leading to flashier flows and changes in channel morphology. The Forests Plan (2006) addresses this issue of forest cover impacts to watershed function with a Desired Future Condition (DFC) of no more than 66% of any 6th level watershed on the forest being in early successional (open or immature) forest cover types. The existing percent open area in all four 6th code HUCs of the project area are less than the DFC.

Table 3.20: Early Successional Forest Cover (open area) in the Four 6th Code HUCs of the Project Area, including Percent Open Area (acreages approximate).

6th Code Watershed	Watershed Acres	Existing Open Acres	Existing Percent Open Area
Sand Creek – White River	30,920	5,528	18
South Branch White River	27,889	10,713	38
North Branch White River	29,248	10,693	37
Carlton Creek	17,845	7,826	44

Data quantified from current HMNF GIS data.

Roads and trails, collectively referred to as routes, are another form of fragmentation that can negatively impact streams and wetlands in a number of ways. As with open space, routes can accelerate the rate of runoff, and may also intercept and divert subsurface flow, reduce groundwater recharge and indirectly lead to the conversion of wetland vegetation types to upland types (Brooks, et. al. 1997). Where inappropriately designed or constructed structures create physical barriers at route/stream crossings, the upstream migration of aquatic organisms can be limited. Route crossings also act as point sources of fine sediment delivered to streams that can impact habitat important to a wide range of aquatic biota. The density of roads and trails (miles/mile^2) is a relative index of the impacts of routes to aquatic resources, and is reported in Table 3.21. Across the four 6th code HUCs of the Project Area, the density of road and motorized trails is ~2.4 miles per square mile of land, with the highest in the South Branch White River HUC (~2.9 mi/mi^2) and the least occurring in the Carlton Creek HUC (~1.9 mi/mi^2).

The national direction for assessing watershed condition (Potyondy, et. al. 2009) rates road densities as <1.0 mi/mi^2 as "Good", 1.0-2.4 mi/mi^2 as "Fair", and >2.4 mi/mi^2 as "Poor". Using these criteria, the watershed condition is poor in the South Branch White River sub-drainage, fair-to-poor in both the Carlton Creek and the Sand Creek-White River sub-drainages, and fair in the North Branch White River sub-drainage. Overall, the impacts to watershed condition from existing road densities within the Project Area are fair, and exceed the Forest Plan standard for Management Area 6.1 (Semiprimitive Nonmotorized). The Forest Plan (2006) identifies the maximum average road densities for all roads in Rural Management Areas (MA 4.4) as 0-3 mi/mi^2 (page II-40). This is met for the Project Area.

Table 3.21: Existing Miles and Densities of Roads and Trails (by 6th Code HUC).

6th Code HUC	USFS Road Miles / Density	USFS Trail Miles / Density	County Road Miles / Density	State Road Miles / Density	Total Miles / Density
Carlton Creek (27.9)	9.8 / 0.4	0.0 / 0.0	52.8 / 1.9	1.0 / 0.0	63.6 / 2.3
Sand Creek – White River (48.4)	21.4 / 0.4	17.9 / 0.4	70.1 / 1.5	0.0 / 0.0	109 / 2.3
South Branch White River (43.6)	27.4 / 0.6	28.7 / 0.7	70.0 / 1.6	5.0 / 0.1	126 / 2.9
North Branch White River (45.7)	11.1 / 0.2	0.0 / 0.0	64.8 / 0.8	10.1 / 0.2	86.0 / 1.9
Total (165)	**69.7 / 0.4**	**46.6 / 0.3**	**258 / 1.6**	**16.1 / 0.01**	**390 / 2.4**

**Numbers in parentheses are watershed area in square miles.*

Biological Resources

The Forest Plan recognizes 118 fish species and 16 mollusk species occurring within lakes and streams of the Forest's boundaries. The White River Watershed Preliminary Habitat Assessment (Annis Institute 2003) identifies 75 species of fish occurring in the White River basin. Many of these species exist within the Project Area, with typical warm-water game fish species including largemouth bass, smallmouth bass, northern pike, walleye, bluegill, and yellow perch. Common cold-water species include brook, brown, and rainbow trout, and mottled sculpin. Lake sturgeon is noted in the Forest Plan as occasionally straying into the White River system. Introduced species include chinook and coho salmon, and steelhead trout, which migrate from Lake Michigan into the White River and its tributaries to reproduce.

The Regional Forester has identified two sensitive aquatic species (Forest Plan, page III-71; *http://www.fs.fed.us/r9/wildlife/tes/docs/rfss_animals.pdf*) that may occur in the White River basin. These species are analyzed under the Biological Evaluation for this project and include the Lake sturgeon and the Creek heelsplitter. There are two management indicator species (MIS) identified in the Forest Plan: brook trout and mottled sculpin.

Within the Project Area, the creeks and rivers on National Forest System lands include the Main, South, and North Branches of the White River and Carlton, Mud, Sand, and Knutson Creeks. All of these are designated as brook trout streams by the State of Michigan. The only fish population data available for any of these streams was an outdated sample collected in an unknown length of lower Carlton Creek in August 1986. Rainbow trout, brook trout, and juvenile coho salmon (up to 10" in length) were recorded. Peterson mark-recapture estimates (combining all length classes by species) are provided below in Table 3.22.

Table 3.22: Electro-fishing Results of Lower Carlton Creek, August 18-20, 1986.

Species	Marked	New	Recaptures	Population Estimate
Rainbow trout	44	46	8	297
Brook trout	31	22	10	102
Coho salmon	7	8	1	63

In a study evaluating the probability of brook trout extirpation, Thieling (2006) identified a threshold range for route densities of 1.8-2.0 mi/mi^2 for predicting extirpation at the watershed scale. Theiling's criteria suggest that these densities in the Project Area are high enough to cause concern for brook trout populations, which are an MIS species on the HMNF. It should be noted that Thieling's criteria were developed for a wide variety of watershed types. Given the relatively low relief and the natural groundwater hydrology of the Project Area, brook trout populations may not be at as high of a risk of extirpation. Continued monitoring at the Forest scale will help better understand the distribution and health of brook trout populations.

Thieling also found that managers should be concerned when agricultural land cover (a subset of open space) is in the 12-19% range, or higher. While data describing agricultural land cover is not available in the HMNF GIS database and precludes such an analysis, Thieling's recommendation reflects how open space can impact brook trout and potentially other aquatic species and is worth considering.

(3.6b) Area of Analysis

The Savannah Ecosystem Restoration (SER) Project Area occurs within four 6th code sub-drainages of the White River basin; North Branch White River, South Branch White River, Sand Creek – White River, and Carlton Creek. The boundaries of each of these sub-drainages are defined and standardized nationally by the US Geological Survey at the 6th code hydrologic unit (HUC) level. While the area of the proposed project encompasses a relatively lesser portion of the four affected 6th code HUCs, the analysis of watershed effects is appropriate at the 6th code scale.

(3.6c) Direct and Indirect Effects of Alternative 1

The area of analysis for direct and indirect effects is defined by the combined outer boundary of the four 6th code HUCs that the project occurs in. Under this alternative poorly maintained roads and stream crossings would continue to contribute non-point source pollution – particularly fine sediments - to bodies of water within the Project Area. Poorly designed and/or installed stream crossings would continue to block passage of aquatic organisms. The high density and poor design of many of the routes would continue to fragment the watersheds and degrade their conditions. Early successional habitat within these watersheds would remain high.

(3.6d) Cumulative Effects of Alternative 1

The area of analysis for cumulative effects is defined by the combined outer boundary of the four sub-drainages that are present within the Project Area. This area was selected because all of the proposed activities occur within these sub-drainages and the effects of these activities should be limited to these areas. Cumulative effects are discussed for the foreseeable future, which is approximately 10 years.

Watershed management in these areas would continue to concentrate on erosion control by upgrading road stream crossings and rehabilitating the streambanks of at-risk areas. Incorporating woody debris in stream channels, along with improving old growth conditions in riparian corridors that are a source of wood debris to channels, would also be an additional focus of future watershed management activities. Overall, water quality and aquatic habitat in these watersheds would remain stable or improve slightly over time. Competition and predation by other fish species upon MIS fish populations in these watersheds would likely remain stable (see Table 3.23).

Table 3.23: Aquatic Management Indicator Species

MIS Species	Habitat	Status	Alternative 1	Alternative 2	Alternative 3
Brook trout (*Salvelinus fontinalis*)	Cold, spring-fed streams	Brook trout are common in the Project Area.	No change	Possible impacts to watershed function, but not likely to impact population	Possible impacts to watershed function, but not likely to impact population
Mottled sculpin (*Salmo trutta*)	Cold, spring-fed streams	Mottled sculpin are abundant in the Project Area.	No change	Possible impacts to watershed function, but not likely to impact population	Possible impacts to watershed function, but not likely to impact population

(3.6e) Direct and Indirect Effects of Alternatives 2 and 3

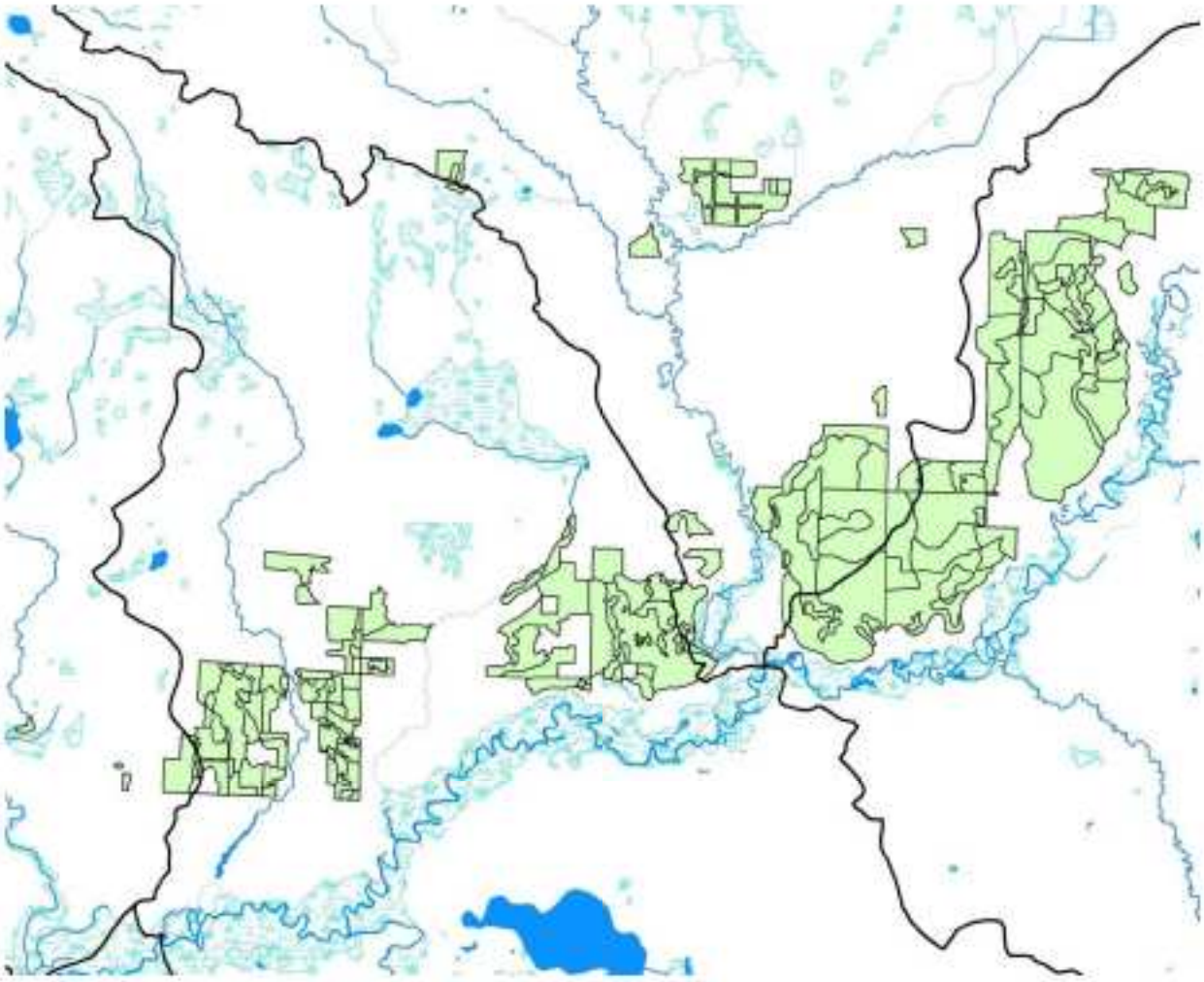
The area of analysis for direct and indirect effects to aquatic resources includes the four 6th code HUCs where treatment occurs. Under both Alternative 2 and Alternative 3, a total of ~4,732 acres (based on the current HMNF GIS data) of management activities are proposed within the Project Area, the majority of which is located in the South Branch White River basin (Table 3.24). The Sand Creek–White River, North Branch White River, and Carlton Creek HUCs contain 28%, 28%, and 2% of the total treatment acres, respectively (Figure 3.6). The use of conservation measures (see Appendix A) and the State of Michigan's Best Management Practices (BMPs), particularly the buffer layout on all streams, would mitigate any direct impacts to aquatic resources from the harvest or treatment of trees or vegetation.

Vegetation treatments would create pockets of non-forest cover (i.e., open acres) in each of the 6th code HUCs, resulting in indirect effects to the flood hydrograph, streambank integrity, channel geomorphology, and sediment budget. The greatest potential change in non-forest cover would occur in the South Branch White River HUC (~10% increase), followed by the North Branch White River and Sand Creek-White River HUCs (~5% each) and Carlton Creek (~1%). For all four 6th code HUCs, increases in non-forest cover resulting from implementation of either Alternative 2 or Alternative 3 would not exceed the DFC of 66% described in the Forests Plan. Adherence to the Watershed Management standards and guidelines (Forests Plan, pages II-18 to II-22), particularly the Streamside Management Zone (SMZ) guideline, would protect aquatic resources from any direct impacts by vegetation management.

Table 3.24: Watershed Areas and Acres of Open Habitat (stratified by 6th code HUCs)

6th Code Watershed	Watershed Acres	Existing Open Acres	Existing Percent Open Area	Total Unit Acres	Proposed Percent Open Area
Sand Creek – White River	30,955	5,528	18	1,426	22
South Branch White River	27,914	10,713	38	2,180	46
North Branch White River	29,277	10,693	37	1,016	40
Carlton Creek	17,864	7,826	44	63	44

Figure 3.6: Map of the wetland areas that are present in the Project Area.



Areas of treatment are represented by solid gray.

Given the generally flat topography and the lack of any road-stream crossings associated with the roads proposed for closure, there is a low probability of either of the action alternatives reducing the existing amounts of sediment input. Closure of forest system roads under Alternative 2 (9.7 miles) and Alternative 3 (10.4 miles) would each provide a very slight reduction of sediment introduced to local streams.

The creation of 19.7 miles of new horse trail proposed under Alternative 2 would not result in sediment impacts as the trail corridor would be constructed to Watershed Management standards and guidelines (Forests Plan, pages II-18 to II-22). The SMZ guidelines should be effective in protecting aquatic resources from impacts of the proposed horse trail, except at the two locations where riders would be allowed access to the river to collect water by bucket. These two sites would be selected and designed with input from the District Fisheries Biologist to reduce the potential for erosion and sediment routing into the stream. Generally, low levels of human foot traffic would not result in erosion; however, site conditions are an important factor to a site's resistance to trampling. These two sites would be monitored for signs of

erosion. If erosion becomes a problem, alternative designs would include creating off-site water sources. Traditional designs such as hardening of the stream bank should be avoided (Forest Plan, pages II-21 and II-22).

The closure of roads under each alternative would provide a small contribution to increased groundwater recharge. Groundwater input into streams helps keep water temperatures reduced and more suitable for coldwater fish species like brook trout and sculpin (Brooks, et. al. 1997). There would be no discernible difference between Alternative 2 or 3 relative to the effect of increased groundwater recharge.

Glyphosate, Triclopyr and Imazapyr are proposed for use to control the growth of woody vegetation in designated KBB areas and the spread of NNIS throughout the Project Area. A complete analysis of the herbicides proposed for use can be found in Appendix C. There are not expected to be any direct or indirect effects to aquatic species from herbicide application under either Alternative 2 or Alternative 3, as BMPs/conservation measures would be followed.

(3.66) Cumulative Effects of Alternatives 2 and 3

Watershed management in these areas will continue to concentrate on reducing the potential of erosion and the associated sediment input into streams, upgrading road stream crossings, maintaining/restoring riparian buffer zones, and improving in-stream and lake habitat. These types of projects should lead to improved water quality and aquatic habitat.

Due to the changes in land use within the White River basin over time, there have also been changes in the flood hydrograph. The intense logging of the 1800s, followed by agricultural development, a period of reforestation, and urban development has altered the characteristics of this basin from what occurred historically (late 1700s). Currently, approximately 30% of the White River basin is now considered open (cropland, open field, or early successional forest). Approximately 10% of the wetlands in the watershed have been lost to drains as part of agricultural/urban development (Rediske et al. 2003). As a result of these changes in land use, there have been increases in the rates of flow delivery and bank erosion and changes in channel morphology and the rates of groundwater recharge. As the human population continues to increase within the watershed, the patterns of development will continue to expand, further aggravating these impacts to hydrologic function and aquatic resources.

Vegetation treatments proposed under both action alternatives would further increase open space within the affected HUCs. This is a concern in the White River basin where non-forested area is already relatively high. The creation of additional non-forest area within this basin would further exasperate impacts to the flood hydrograph and other aquatic resources, but do not exceed the DFC in the Forest Plan. These impacts to hydrologic function are known to continue downstream and may impact aquatic resources outside the Project Area, but are difficult to monitor, much less quantify.

(3.7) Physical Resources

(3.8) Air Resources

(3.8a) Existing Condition and Resource-Specific Information

There were no public issues specifically related to the air resource. Prescribed burning to create barrens habitat is the main activity that would have the most potential impact to the quality of the air resource. For this reason, the effects analysis for the air resource focuses on the effects from prescribed burning activities. The analysis also discusses greenhouse gas emissions and its contribution to global climate change.

Site-specific burn plans are developed for each burn unit. These plans outline the environmental conditions required for conducting burn activities (i.e. wind direction, humidity, and temperature thresholds), the amount of resources required, the desired time of year, contingency plans, and any site-specific burning restrictions that may apply. Burn units are developed by considering existing control lines (i.e. roads, plow lines, etc.), fuel types, and natural features. The size of individual burn units can vary considerably, but efforts are made to keep the burn units to a size than may be safely completed within one operational period (one day).

Affected Environment: Frequent weather fronts pass through the Project Area, especially in the spring and fall, resulting in southeast, south, west and northwest winds (VCIS 2009). Prevailing winds during the burn season (March to November) are generally south to west, with local onshore winds out of the west that dominate prevailing winds during calmer weather. Mixing heights vary, but average 4,200 feet in the afternoon during burning season (VCIS 2009).

Projects implemented by the Forest Service must follow all State and Federal regulations governing air quality, including meeting ambient air quality standards (NWCG 2001). Chief among these is the Clean Air Act (CAA) as amended in 1990, and the Draft Michigan State Implementation Plan (DMSIP), which is a state prepared implementation document of the CAA. The Michigan Department of Natural Resources and Environment (DNRE) is the agency which monitors and regulates air quality in the state.

The CAA prescribes the National Ambient Air Quality Standards (NAAQS) for criteria pollutants to limit the negative human health and welfare impacts from air pollution. These include: Particulate Matter <10 microns in diameter (PM_{10}), Particulate Matter < 2.5 microns in diameter ($PM_{2.5}$), Total Suspended Particulate Matter (TSP), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O^3), Carbon Monoxide (CO), and Lead (Pb). Areas failing to meet the established standards are considered "non-attainment areas" and individual states must develop plans to improve air quality in these areas (NWCG 2001).

Particulate Matter: Since October 4, 1996, all areas in Michigan have been in compliance with PM_{10} NAAQS. Due to the recent focus on $PM_{2.5}$, and because of the relatively low concentrations of PM_{10} measured in recent years, Michigan's PM_{10} measurement network has been reduced to minimal levels. On August 18, 2010, the EPA proposed the 7-county Southeast Michigan Area a

non-attainment area for $PM_{2.5}$ based upon 2005-2007 data. In addition, the EPA proposed Kent and Ottawa Counties, on the west side of the state, as non-attainment areas for $PM_{2.5}$ based on this data. The two Grand Rapids monitoring stations recorded a mean annual average of 11.8 and 12.8µg/m³ respectively for Annual Mean Concentrations of $PM_{2.5}$, below the 15µg/m³ requirement (2006-2008). Muskegon County and the Project Area have a 3 year $PM_{2.5}$ average of 10.5µg.m³, also below the average. A detailed assessment of $PM_{2.5}$ (24 hour average) concentrations for 2003-2008 shows Michigan's levels were consistently below the old 65µg/m³ standard (3-year average), and with the exception of Dearborn (in eastern Michigan) and are currently under the new 24-hour $PM_{2.5}$ NAAQS measurement of 35µg/m³. Kent and Ottawa counties are approximately 22 to 25 miles south and southeast of the project area and upwind of the prevailing winds. Because of the distance, prevailing winds and winds permitted for burning the project area should not impact these airsheds.

Background concentrations of PM and other pollutants originate primarily from industrial facilities, automobiles, residential and commercial buildings, agriculture activity, and road dust (USEPA 2010). Some of these sources are temporary (such as smoke from wood stoves, fire places, field burning, and wildfires that often coincide with prescribed burning season), while others are constant (such as industrial sources and power plants). Disking and harvesting activities on agricultural lands can produce large amounts of dust and other particulates; this action is temporary and seasonal, but may overlap with prescribed burning.

Table 3.25: Emissions by Category Report – $PM_{2.5}$ – Tons/Year

County	Industrial/Commercial	Agricultural	Forest Service Prescribed Burn	Other
Muskegon	1,180	183	0	794
Oceana	198	126	70	368
Newaygo	235	13	0	245

Visibility: The CAA also prescribes measures called Prevention of Significant Deterioration (PSD) to limit the impacts to visibility in certain areas. Class 1 areas are those with high air quality that allow only minor additional reductions to visibility (NWCG 2001). There are two Class 1 areas in Michigan, the wilderness portion of the Seney National Wildlife Refuge and Isle Royal National Park. Both of these are in the Upper Peninsula. Sleeping Bear Dunes and Indiana Dunes National Lake Shores, though important scenic areas, are not designated Class 1 areas. None of these areas would be impacted by the project due to their distance from it. The entire Manistee National Forest and surrounding counties are designated a Class 2 area, which follow the normal rules of visibility. Visibility is typically worst during hazy summer days under entrenched high pressure systems and humid conditions or during periods of calm, moist air during or preceding rain, snow, or fog events.

There are three types of prescribed burning; growing season, dormant season, or pile burning. Dormant season burning occurs in the spring and fall when plants are not exhibiting growth. Growing season burning occurs during the summer months when plants are actively growing and pile burning occurs in the late fall, winter or early spring when the ground is either snow covered or wet. Since prescribed burning requires dry unstable air, most of the burning will

occur during drier portions of the spring, summer and fall. Therefore, most emissions would not overlap with times of poor background visibility.

Ozone: Ozone (O^3) is an air pollutant that is formed in the atmosphere from a chemical reaction of Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOC's) plus heat. The ozone season for Michigan is considered April- October, which overlaps the prime burning season. The HMNF has two counties on the Forest that were designated as non-attainment areas by the EPA on April 30, 2004 with respect to the 1997 8-hour ozone NAAQS of 0.08 parts per million (ppm). The two counties, Mason and Muskegon, were re-designated to maintenance status by the EPA on May 16, 2007 due to measured improvements in ozone. As a part of this process, the State of Michigan developed EPA approved maintenance plans for these counties (71 FR 70915). The maintenance plans are designed to keep the counties in attainment of the 0.08 ppm threshold through 2018. These plans include county-by-county air emission projections from all types of pollution sources that form ozone, primarily nitrogen oxides (NOx) and volatile organic compounds (VOCs). Sources of NOx include anything that burns fuel. VOCs can come from the evaporation of fuels (e.g. gas stations) or natural emissions from vegetation.

The ozone problem in western Michigan is known to be a regional transport issue and not one of local origin. In their July 15, 2003 letter to EPA regarding ozone non-attainment designations MDNRE (MDEQ) states:

> *"Overwhelming (not regional) ozone transport is the sole reason for nonattainment levels of ozone at many monitors in Michigan. Community support for nonattainment designations and positive actions within some of these areas is hindered because such a designation results in regulatory mandates based on the erroneous premise that a local area should be held responsible for their air quality. Some of the ozone receptor counties in West Michigan have minimal industry and are very sparsely populated. Local emission reductions do not reduce ozone concentrations at shoreline monitors even in counties with urbanized areas."*

As stated above the nature of the problem is a regional-scale phenomenon. The primary pollutants need time to react in the atmosphere before forming ozone. This leads to impacts that are felt at a considerable distance downwind from the pollution sources. This is the case for western Michigan, which includes the counties within the boundaries of the Huron-Manistee National Forest (Wickmen 2010).

Greenhouse Gases: Fires also produce gases that are emitted into the atmosphere such as carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_X), and methane (CH_4). The burning of fossil fuels in internal combustion engines is also a source of these gases. Most of these gases generally pose little or no direct risk to public health since fires are spatially and temporally dispersed, and the emissions are rapidly diluted into the atmosphere near their source (Sandberg and Dost 1990). However, gases such as CO_2 and CH_4 are the primary anthropogenic sources of greenhouse gases that may have a direct effect on global climate change.

The temperature of the earth's atmosphere is regulated by a balance between the radiation received from the sun, the amount reflected by the earth's surface and clouds, and the amount of radiation absorbed by the earth and its atmosphere. Greenhouse gases (GHG) keep the earth's surface warmer than normal because they absorb infrared radiation from the earth and, in turn, radiate the energy back down to the surface. While these atmospheric gases occur

naturally, there has been a rapid increase in concentrations of greenhouse gases in the earth's atmosphere from anthropogenic sources since the start of industrialization, which has caused concerns over potential changes to the global climate. The largest effect on climate change is from CO_2 emissions.

Global emissions are measured in terms of teragrams (Tg), where one Tg is equivalent to 10^6 metric tons. The estimated global CO_2 emission rate from combustion of fossil fuel for the year 2008 is approximately 30,377 Tg (EPA 2010). Scientists continue to assess and estimate the total global effect of warming or cooling of various GHG's. The global average surface temperature in the 1906-2005 time period has increased by 1.3±0.32°F. Eleven of the twelve warmest years globally since approximately 1850 have occurred during the years 1995 to 2006 (IPCC 2007). Future projections of GHG during the 21st century have been made using a number of emission scenarios. Based on model simulations applied to various GHG's, the U.N. Intergovernmental Panel on Climate Change (IPCC) has projected an increase in globally average surface temperatures ranging from 1.1 to 6.4°C (IPCC 2007). This level of global climate change could lead to devastating results such as more erratic weather patterns, coastline erosion and flooding, and widespread ecosystem degradation.

(3.8b) Area of Analysis

The direct and indirect effects analysis area for the air resource consists of the atmosphere covering the HMNF and surrounding private lands. Due to the extent of the burning proposed this document will address the direct and indirect effects on Muskegon, Oceana, and Newaygo Counties of Michigan. These counties are immediately downwind of the Project Area and would experience the greatest impact to their air resource.

The cumulative effects analysis for the air resource related to particulate matter emissions consists of the atmosphere over the HMNF and adjacent private lands up to 5 miles from the Project Area. The reason this analysis area is used is because the smoke modeling for this project indicates that emissions beyond this distance from the burn location are negligible (about 1µg/m³ (24-hour average)). The timeframe for the cumulative effects analysis is 5 to 10 years, since that is the expected time period for the implementation of this project.

The cumulative effects analysis area for the air resource related to other gas emissions consists of the atmosphere with no maximum boundaries. This analysis area was used since these gases are emitted into the atmosphere and persist for long periods of time.

(3.8c) Direct and Indirect Effects

Alternative 1

Under this alternative there would be no direct or indirect effects to air quality resulting from this project, as no activities would take place. Current use and activities that produce pollutants and emissions would continue. In the past, these have not contributed towards excessively degraded air quality and would not be expected to do so in the future. Numerical values for the predicted emissions for all Alternatives are shown in Table 3.27.

The prescribed burning (343 acres) activities associated with the Savanna/Barrens Restoration project would still occur within the boundaries of the Project Area. A wildfire in the Project Area would be likely to produce greater emissions than a prescribed burn of the same size in the same area because it is likely to ignite and burn during periods of lower humidity, stronger winds, higher temperatures and lower fuel moistures causing significantly greater fire behavior and greater fuel consumption.

Alternative 2 & 3

The goal of Alternative 2 is to balance the restoration of the savanna ecosystem with the present recreational experience, and the goal of Alternative 3 is the increased protection of savanna restoration activities from the existing recreational use. The management activities associated with wildlife habitat creation and timber harvesting are the same under both Alternatives 2 & 3 and include 2,542 acres of savanna creation (cutting, seeding, and burning), 1,050 acres of additional prescribed burning, 761 acres of red pine thinning, 519 acres of KBB opening restoration (cutting, mowing and burning) and 23 acres of oak/aspen clear-cutting. This would result in approximately 4,100 acres of initial prescribed burning, with the amount of follow-up burning necessary during the coming decade being dependent on the floristic response. The majority of the burning would be on a landscape level, burning a wide variety of stands in a contiguous burn block at one time. These blocks range from 44 to 988 acres in size with the average size being approximately 450 acres. Because of logistical and biological constraints no more than approximately 2,000 acres of prescribed burning would be implemented annually.

For purposes of predicting smoke emissions, it is estimated that the maximum amount of burning that the Forest could practically accomplish in one day is no greater than 1,000 acres. Modeling results indicate that burning 500 acres of forest land under summer conditions (e.g. 75°F, about 10 mph wind speeds, RH 35%, neutral atmospheric conditions, and a 3,000 ft mixing height) would produce a maximum $PM_{2.5}$ concentration of 29 $\mu g/m^3$ at a distance of approximately 4.5 miles from the fire line. This would be below the 35 $\mu g/m^3$ threshold (24 hour average). Using the same conditions and distances, burning 1,000 acres would produce $PM_{2.5}$ concentrations of 38 $\mu g/m^3$ (24 hour average). This would drop to less than 35 $\mu g/m^3$ (24 hour average) at a distance of 5.9 miles from the burn. It is reasonable to expect the actual $PM_{2.5}$ concentrations would stay below the 24 hour NAAQS of 35$\mu g/m^3$ (24 hour average) if burning conditions were more favorable than those modeled. Modeled conditions predicted a plume rise of 3,000 feet. Observed broadcast burning gives plume rise of 5,000 feet or more which would allow for greater dispersion and less impacts for any given area. Concentrations are not compared against the annual standard since a prescribed burning project is a temporary source of emissions lasting only a few days.

This type and amount of burning is similar to past burning practices on the HMNF. The air quality standards have not been exceeded or substantially impacted be these past activities. While it is predicted that the level of burning proposed under either Alternative 2 or 3 would have short-term site specific impacts to air quality from $PM_{2.5}$ emissions, these impacts would not be substantial.

The GHG emissions from the proposed prescribed burning activities that have the most potential to contribute to global climate change were also estimated and are displayed in Table 3.26.

Table 3.26: Estimated GHG Emissions from a 500 acre Prescribed Burn

Compounds Released	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxides (NO_x)
Emission Results for Burning (lbs)	661,500	31,500	8,000

(3.8d) Cumulative Effects

When considering the past, present, and reasonably foreseeable future, there would be approximately 10,000 acres of annual burning for habitat creation and maintenance. Past burning on the forest has been determined to emit small quantities of PM for very short periods of time. No violations have been issued by the MDNRE or the EPA that would indicate non-compliance with air quality standards. Although the amount burning on the HMNF increases the potential to burn more acres than modeled, the maximum capacity for any given day would be approximately 1,000 acres with an average of approximately 500 acres burned per day. For this reason, the expected cumulative effects from PM emissions would stay below the NAAQS as discussed in the direct and indirect effects. Other sources of air pollution (such as industry, vehicles, and residential wood combustion) would continue to contribute to existing background air quality concentrations, which are generally low. The cumulative effects of these existing sources of pollution, together with the maximum 1,000 acres of daily burning anticipated under both alternatives, would result in minimal impacts to air quality related to PM emissions.

A First Order Fire Effects Model (FOFEM) analysis was used to estimate the primary GHG emissions from the proposed prescribed burning activities that have the most potential to contribute to global climate change (Table 3.27). These gas emissions are based on the maximum amount of annual burning that would occur over a ten year period.

Table 3.27: Primary Greenhouse Gas Emissions from Prescribed Burning

Type of Gas	Alt 2 & 3 Annual Emissions (metric tons/acre)	Alt 2 & 3 5 Year Total (metric tons/acre)	Alt 2 & 3 10 Year Total (metric/tons/acre)
Methane (CH_4)	60	300	600
Carbon Dioxide (CO_2)	12,620	63,100	126,200
Nitrogen Oxides (NO_X)	20	100	200

The net addition to the annual global emission rate for GHG is so small that it would result in no detectable change in the cumulative effects in the atmosphere associated with global climate change. The annual CO_2 output that would be anticipated under the maximum number of acres of proposed activities would be projected at 12,620 metric tons or 0.0012 Tg. The annual CO_2 output from these activities would be approximately .00000495 percent of the estimated global CO_2 emissions rate from combustion of fossil fuels for the year 2000. This net addition to the annual global emission rate is so small that it would have no detectable change in the cumulative effects of CO_2 in the atmosphere associated with global climate change. Since the

amounts of CH_4 and NO_x are even less than that of CO_2 relative to global outputs, no detectable change in the cumulative effects from these gases related to global climate change is expected.

(3.9) Fuels

(3.9a) Existing Condition and Resource-Specific Information

Housing Density: The population in the vicinity of the Project Area is approximately 1,100 people. The housing density in these two Townships is approximately 28 houses per square mile (2000 US Census Data), with an average of 1.75 homes per 40 acres.

Fire Regimes: The current vegetation in the Project Area is characterized by three natural (historical) fire regimes (out of a total six fire regimes which occur within the HMNF). These include:

1. Fire Regime (FR) 1 represents landscape ecosystems historically experiencing frequent stand-replacing fires (HMNF 2006). These occur in the very dry outwash plains underlain by coarse-textured sandy soil. In the Project Area this would include jack pine/jack pine oak sands, pine barrens, and upland openings.

2. Fire Regime 2 represents landscape ecosystems historically experiencing large, catastrophic stand replacing fires at lower frequencies than those associated with FR1 (HMNF 2006). These occur on the outwash plains and ice contact landforms underlain with sandy and loamy sand soils. In the Project Area, this would include red and white pine and oak stands which can experience surface fires that periodically reduce the fine fuel loading, but do not kill the majority of trees.

3. Fire Regime 3 represents landscape ecosystems historically experiencing relatively infrequent stand-replacing fires, at much longer intervals than FR1 and FR2 but may experience frequent surface fires burning in the leaf layer. In the Project Area this would include aspen, hardwood, and lowland species (HMNF 2006).

Condition Classes: The Project Area is classified according to its condition class (CC), which is based on the departure from the historical fire regimes described above. Extensive areas of the HMNF are determined to be either CC2 (moderate departure from the historic fire regime), or CC3 (high departure from the historic fire regime).

The Project Area is considered to be in CC3. Condition Class 3 occurs where fire regimes have been altered from their historical range (Schmidt, et. al. 2002). Areas in CC3 are at a high risk of losing key components of the ecosystem and for experiencing increases in the size, intensity, and severity of wildland fires due to the increases in fuel build up and arrangement. In CC3, fires pose a relatively high risk to life and property, and the fire intensity is more severe, impacting large trees that would normally survive fires of lower intensity.

Condition Class 2 occurs where historical fire regimes have been moderately altered from their historical range (Schmidt, et. al. 2002). The negative aspects of being in a CC2 includes a moderate risk of losing key components of the ecosystem, an increase in fire size, intensity, and severity, and its effect on the landscape, although less so than CC3. This condition class is associated with moderate risk to life and property.

Condition Class 1 occurs where historical fire regimes are within their historical range and vegetation attributes are intact and functioning within a historical range (Schmidt, et. al. 2002).

One of the goals of the Forest Plan is to move areas that are in CC3 towards CC2 or, if possible, to CC1. This typically requires intensive vegetative treatments followed by the re-introduction of fire into the ecosystem utilizing prescribed burning. Where appropriate and reasonable, forested stands in CC2 would require moderate levels of treatment, with emphasis on the continued use of prescribed fire as a restoration and maintenance tool.

Table 3.28: Acreage and Percentage of Jack Pine and Red Pine-Dominated Stands On National Forest System Lands within the Project Area

Forest Type	Acreage	% of Total	Regime Class	Condition Class
Pine	1,696	11.3%	1	3
Pine/Oak	1,715	11.4%	2	3
Oak	7,206	48.0%	2	3
Aspen/HWD	3,245	21.6%	3	3
Open	1,150	7.6%	1	2
TOTAL	**15,012**			

Fuel Models: Forest fuels are classified into four basic groups. These are based largely on vegetation type and include: 1) grass, 2) brush, 3) timber, and 4) slash. The differences in fire behavior within these groups are related to the total fuel load and how it is distributed. Fuel loading and depth are measurable properties used for predicting the odds that a fire would be ignited under specific conditions, its rate of spread, and its intensity (Anderson 1982).

Fuel models (FM) found in the Project Area include Models 3, 4, 8, and 9; the majority of the area is comprised of FM8 and FM9 (89% of area). Smaller areas are represented by FM's 3 and 4 (11% of area). Fuel models 3 & 4 exhibit fairly active fire behavior and a greater possibility of a catastrophic wildfire than FM's 8 or 9. The distribution of the various fuel models can be found in Table 3.29. The representative fuel models are described in detail below (Anderson 1982).

Table 3.29: Fuel Models of Project Area

Forest Type	Fuel Model	Total Acreage	% Treated
Open	3	1,150	8
Jack Pine/JP-Oak	4	515	3
Pine/Pine Oak	9	2,896	20
Oak	9	7,206	47
Aspen/Hardwood	8	3,245	22
Total		**15,012**	

- *Fuel Model 3*: The primary carrier of fire is continuous coarse grass. Grass and shrub load is relatively light; fuelbed depth is about 2.5 feet. Shrubs are not present in significant quantities to affect fire behavior. Fires are surface fires that move rapidly through the cured grass and associated material. Annual and perennial grasses are

included in this model, and total fuel loadings are approximately 3.0 tons per acre. In the Project Area, FM 3 is currently represented by grass and forb-dominated openings and accounts for approximately 8% of the Project Area.

- *Fuel Model 4:* Fire intensity and fast-spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous overstory. Stands of mature shrubs, 6 or more feet tall, and the closed jack pine stands of the north-central states are typical candidates. Besides flammable foliage, dead woody material in the stands contributes to the fire intensity. The height of stands qualifying for this model depends on local conditions. A deep litter layer may also hamper suppression efforts. Fuel loading is typically 16 tons per acre. In the Project Area, FM4 is represented by jack pine/jack pine-oak stands and accounts for approximately 3% of the Project Area.
- *Fuel Model 8:* Slow-burning ground fires with low flame lengths are typical, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare-up. Closed canopy stands of pine or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and twigs because little undergrowth is present. Fuel loading is typically 5 tons per acre. In the Project Area, FM8 is represented by aspen stands and accounts for approximately 22% of the Project Area.
- *Fuel Model 9:* Fires run through the surface a little faster than FM 8 and have longer flame heights. Both long-needle conifer stands and hardwood stands are typical. Fall fires in hardwoods are predictable, but high winds can actually cause higher rates of spread than predicted because of spotting caused by the rolling and blowing of burning leaves. Closed stands of long-needle pine, for example red pine, are grouped in this model. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowning. Fuel loading is typically 3.5 tons per acre. In the Project Area, FM9 is represented by red pine, red pine-oak, and hardwood-dominated stands and accounts for approximately 67% of the Project Area.

The fuel model descriptions described above include a figure for total fuel loading, given in tons per acre. That figure for fuel loading can be further broken down into four sub-categories based on the diameter of the fuel particles. Table 3.30 identifies the total fuel loading by subset:

Table 3.30: Fuel Loading Subsets

Fuel Model	Fuel Size – tons per acre				
	< ¼ inch	¼ to 1 inch	1 to 3 inch	Live	Total
3	3.0	0.0	0.0	0.0	3.0
4	5.0	4.0	2.0	5.0	16.0
8	1.5	1.0	2.5	0.0	5.0
9	2.9	0.4	0.2	0.0	3.5

While total fuel loading is an important factor affecting fire behavior, the fuel category that contributes to high-intensity crown fires is the live component. It is FM3 and FM4 represented by grasses, jack pine and jack pine-dominated stands respectively, that have a large amount of their fuel load in the needles of living trees, as well as overall fuel loading. These two fuel models account for approximately 11% of the Project Area. The smaller fuels, especially the <1/4 inch and the 1/4 inch to 1 inch categories, contribute the most to surface fire intensity.

High fuel loading in these smaller categories can cause a light to moderate intensity surface fire to trigger a high-intensity crown fire.

The activities proposed under Alternatives 2 and 3 would result in approximately 4,100 acres of initial prescribed burning. Some areas would likely be burned more than once over the course of the next ten years, based on the vegetative response and the desired future conditions of individual areas. The majority of the burning would be on a landscape level, burning a wide variety of stands in a contiguous burn block at one time. These blocks would range in size from 44 to 988 acres in size with the average size being approximately 450 acres. Because of logistical and biological constraints no more than ~2,000 acres of prescribed burning would be implemented annually, with the daily burn limitations being no more than what could be accomplished within one operational period (one day).

(3.9b) Area of Analysis

The Area of Analysis for the fuels projects is the Project Area (~26,000 acres). Of this, approximately 15,000 acres (58%) is in Forest Service ownership. The treatments affecting fuels would not extend beyond the Project Area boundary. The area is predominately rural in nature with farmland to the north and east and permanent homes and hunting camps inter-mixed throughout the area. This area of analysis would apply to the direct, indirect, and cumulative effects.

(3.9c) Direct and Indirect Effects

Alternative 1 proposes no new treatments to convert oak and pine forests to savanna; to thin, regenerate, or non-commercially treat aspen, pine, and oak stands; or to non-commercially enhance openings for TES, RFSS, and game species. Alternatives 2 and 3 propose to commercially or non-commercially harvest aspen, pine and oak cover types, and to manage non-forest types. Manual, mechanical, prescribed fire, and herbicide treatments to control certain woody and herbaceous species are included in Alternatives 2 and 3.

In Alternative 1, fuels would not be affected by prescribed fire and mechanical equipment treatments beyond the 343 acres of broadcast and pile burning described in the Savanna/Barrens Restoration Project. There would be no changes in the fuel condition classes in the Project Area and the Fuel Models would remain constant except for gradual changes caused by stand maturation and natural conversion. Fuel Models 3 and 4 would remain intact. The possibility of a large stand replacing wildfire would exist with this alternative.

In Alternatives 2 and 3, approximately 4,692 acres of varying types of fuels would be affected by prescribed fire and mechanical equipment treatments. This accounts for all areas receiving any type of treatment within the Project Area under this project and is in addition to the 343 acres of broadcast and pile burning implemented under the Savanna/Barrens Restoration Project. These treatments would change the condition class within the Project Area from a CC3 to a CC2 through the use of mechanical methods to make large-scale changes to the structure of the fuels, followed by a prescribed burning program that would simulate the natural fire regime as closely as possible. As time passed and mechanical and prescribed burns continued the CC2 stands would be converted into CC1. This would represent a better approximation of historical

fire regimes and vegetative attributes that are within their historical range (Schmidt, et. al. 2002).

There would be the conversion of the area from its present four Fuel Models to a more uniform area of 2, or possibly 3 Fuel Models. This would simplify the understanding of the area's fire behavior and therefore the ability to safely manage the burn program. There would be a continuum of open land blending into barrens and closed canopy woodlands along the river. Fuel Model 4, the most susceptible to catastrophic wildfire, would be treated and its volatility reduced.

Treatments in Alternatives 2 and 3 would modify the vegetative structure, amount, and continuity. Fire behavior would more likely be a surface fire than a crown fire. A surface fire would have shorter flame lengths and lower rates of spread than a crown fire, thereby providing more protection of life and property (Graham, McCaffrey, and Jain 2004).

(3.9d) Cumulative Effects

In Alternative 1, the forest would be unmanaged and there would be a slow succession to a closed canopy forest in this area. This would lead to an accumulation of dead and down standing wood, as well as an increase in ladder fuels, thus making the area susceptible to catastrophic stand replacing wildfires.

Alternatives 2 and 3 would move the area to a more open vegetative state that would allow easier access for future fire suppression if required. There would also be less likelihood of a catastrophic wildfire.

Since forested stands are dynamic systems, it is expected that the fuels in the Project Area would continue to be managed for decades. It is anticipated that additional treatments would need to be implemented in the same area as savanna and forested stands mature and as fuels continue to amass in the area as part of the natural succession of forests.

(3.10) Soils

(3.10a) Existing Condition and Resource-Specific Information

Landtype Associations and Ecological Land Type Phases

Landtype Associations (LTAs) are contiguous areas of land that have similar glacial landforms, overstory plant communities, and soil associations. LTAs correspond with different depositional and erosional landforms that formed as a result of the most recent glacial period. Glacial deposits in northern Lower Michigan consist primarily of sand, silt, clay and gravel. Silt and clay layers are most commonly associated with areas of slow-moving or ponded water. Sand and gravel layers are most commonly associated with more rapidly moving waters. Land acquisition resulted in the more productive silt and clay landforms being retained and developed, principally for agricultural uses, by private landowners, and less productive sandy landforms becoming National Forest lands.

There are eight LTAs present on the Huron-Manistee National Forests; five of these occur within the Project Area. LTAs have consistent general trends in soil parent material and vegetation, but differences in productivity, water table depth, slope, drainage, soil texture, and wildfire frequency and intensity that affect potential natural vegetation. These influences are characterized and mapped as Ecological Land Type Phases (ELTPs), and serve as the basic units of land management (Cleland, et. al. 1993). ELTP descriptions represent a summary of information about a specific site relative to the landform, soils, ground flora, and potential natural vegetation. The ELTPs for the sites proposed for treatment in the Project Area are listed on the Treatment Unit Cards (located in the Project File). Table 3.31, Landtype Characteristics for All Ownerships displays the LTAs and ELTPs that are present within the Project Area, and their relationship to soil names (USDA NRCS/FS 1996).

Table 3.31: Landtype Characteristics for All Ownerships within the Project Area

LTA	Formation	Topography	Ecological Species Group		Associated ELTPs	Acres in ELTP	Soil Types
1- Outwash Plains	Deposited by water from melting glaciers.	Comparatively level, but may be pitted or dissected.	Overstory: jack pine, red pine, black, white, and pin oak.	Understory: blueberry, hair-grass.	210 211	6,594	Plainfield
					212	1,283	Plainfield
					213	874	Arkport Chelsea
2 - Ice-Contact Hills	Formed in coarse to medium textured sandy and gravelly material.	Hilly, with gently rolling to moderately steep slopes.	Overstory: black and white oak, red maple, white pine, and red pine.	Understory: starflower.	220	3,573	Grattan
					222	2,120	Grattan
					224	614	Covert
					221 223 225	769	Coloma Toogood

Table 3.31 (continued): Landtype Characteristics for All Ownerships within the Project Area

LTA	Formation	Topography	Ecological Species Group		Associated ELTPs	Acres in ELTP	Soil Types
3 - Sandy Morainal Hardwood Hills	Formed in sandy, gravelly, and loamy material overlying deposits ranging from sandy loam to clay.	Hilly, ranging from gently rolling to steep.	Overstory: white pine, beech, red oak, and red maple.	Understory: viburnum.	230 233 241 245	560	Spinks Okee Benoa
4 - Wet Sand Plains and Lake Plains	Formed in coarse and medium-textured sandy materials.	Level, with low ridges in some areas.	Overstory: red maple, red oak, and white birch.	Understory: bunchberry, leather-leaf, blueberry.	262 263	165	Saugatuck Jebavy Pipestone
					272 273 274	398	Granby Kingsville Glendora
5 - Alluvial, Fluvial, and Organic	Develop or accumulate along streams in depressions.	Nearly level.	Overstory: white cedar, tamarack, black spruce, hemlock, or red maple.	Understory: Labrador tea, Canada violet.	250 280 282	1,616	Napoleon Houghton Carlisle Kerston Adrian

Soil Productivity

Soil productivity varies naturally by ELTP, and is affected by past land uses which may have caused loss of soil organic matter, increased soil bulk density (compaction), or accelerated erosion. Soil productivity is maintained and improved by:

- Retaining or replenishing organic matter and its associated nutrient and water holding capacity;
- Reducing compaction so that water infiltration rates and plant growth are not impeded;
- Limiting soil displacement so that erosion is within naturally occurring rates; and
- Preventing contamination with organic chemicals. (Brady and Weil 2002).

Soil productivity is influenced by local topography, proximity to open water, depth to the water table, the amount and type of vegetation cover, and how that cover has been established or maintained. Many forests, located on well drained and level topography, have been impacted by timber management or past agricultural practices. In other locations, physiographic limitations have resulted in less intensive management. For example, soils in the riparian areas or on steep slopes adjacent to the White River have been passively managed for decades because the combination of soil characteristics and topography are not conducive to repeated timber harvesting. As a result of these situations, many locations have received moderate to

heavy impacts to soil productivity, and other areas have received little to no impacts to soil productivity. The characteristics of the various ELTPs and their capacity to sustain productivity associated across a range of activities have been published in the Soil Survey of Oceana County (USDA NRCS/FS 1996). The effects on soil productivity that may be associated with the management activities included in the project can be assessed by considering the soil organic matter and the compaction and erosion potential.

Organic Matter: The amount and type of organic matter in forested soils varies by the type of forest, the history of land use, the parent material, and the climate. Organic matter (in the form of decaying leaves, sticks, etc.) collects on the surface over time. As this material breaks down through natural processes, it forms a layer on top of the soil profile. This layer serves not only as a source of nutrients that are slowly released back into the profile, but also as a protective buffer against the forces of erosion and compaction. Within the soil profile, organic matter consists primarily of dead and decaying roots of plants and trees. As these roots shrink and decay, they not only add nutrients to the soil system, but also provide channels to increase the rates of infiltration. As a result, increased levels of organic matter typically equate to increased levels of soil productivity. Fluctuations in the organic matter that is present in a particular system at a given time may occur as a result of both human activities (i.e. timber harvesting) and natural events (i.e. wildfire).

The effects on the soil organic matter depend on the timing and methods of forest vegetation treatment (including wood removal, prescribed fire, and skid trail, landing and road construction), the type and amount of vegetation that is re-established after a treatment, wildlife and plant habitat improvement activities in non-forested areas (including prescribed fire, disking, seeding and herbicide application), equipment limitations, and erosion from wind and water. Maintenance of soil organic matter is vital to sustaining soil productivity because it is the principal source of nutrients for vegetation and also affects soil fauna and organisms.

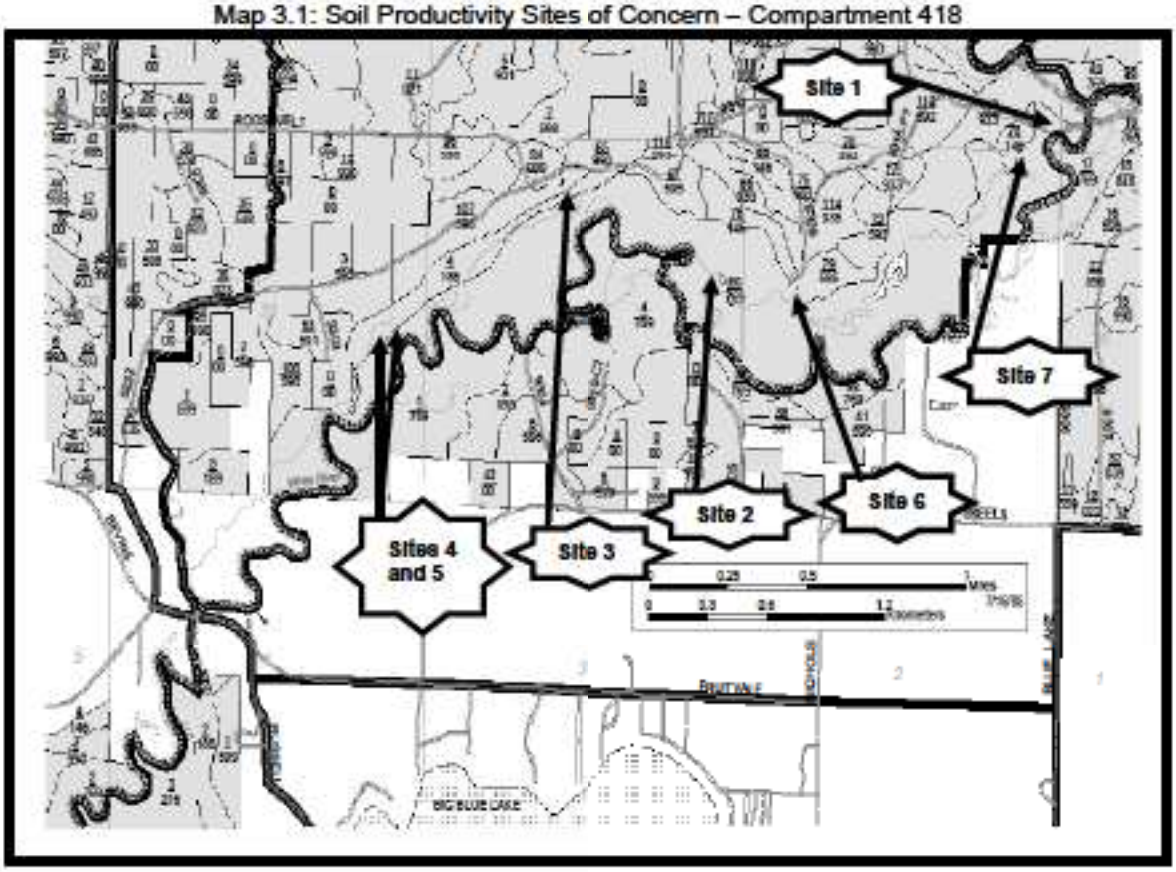
Compaction: Compaction occurs when the pore spaces within a soil are reduced due to the compression of soil particles through natural processes (rainfall) or human activities (motor vehicles, timber harvesting, historic campsites, etc.) As a result, the weight/unit (bulk density) of the soil is increased. Bulk density is used as the measurement for compaction. Compaction results in reduced levels of infiltration and microbial activity within the soil profile, increased run-off potential, and the inability of vegetation to become established or thrive. The susceptibility of a soil to compaction depends on the amount of organic matter in the soil, the overall texture of the soil, and the soil moisture. In general, the greater the organic matter and clay content in a soil, and the drier the soil is when a mechanical treatment occurs, the more resistant to compaction the soil is (Greacen and Sands 1980).

Erosion: Erosion is a natural process involving the detachment and movement of soil by water and wind. Accelerated erosion occurs at an increased rate as a result of human activities, which promote the washing or blowing away of soil faster than new soil can form. As a result of accelerated erosion, suitable soil depth for rooting plants is reduced. (Brady and Weil 2002). Soil loss rates are influenced by a variety of factors, including: soil type and texture, slope, vegetation, and land use (i.e., forested, developed, agricultural).

Existing Areas of Highest Impact

Relative to soil productivity concerns at a site-specific level, the following sites have been identified within the Project Area:

Map 3.1: Soil Productivity Sites of Concern – Compartment 418



Site 1: This is the site of an illegal hill climb area. This use has come from a cut through a mid-level topographical bench, leading to two mud holes in the river bottom near the confluence of the North and South Branches of the White River. Trenches and rutting on the slopes are apparent and soil has moved downslope. This site has been identified for rehabilitation and will be completed as part of the 2010 State of Michigan ORV Restoration Grant.
Total Area Impacted: ≤ 1 acre.

Site 2: This site is referred to as Poison Springs. An historic Forest Road leads down into the main basin of the White River drainage. This road comes to a T-intersection. To the west, the road leads to a mudhole that has been created in an oxbow. To the east, the road slopes into an historic campsite that is located along a creek (identified during the Scoping process as Poison Springs). The campsite serves as the terminus of the eastern spur. There are cutbanks located along the historic Forest Road and the movement of soil downslope is evident. The western spur has rutting evident in the wet basin soils. Rutting is also present on the eastern spur and compaction has occurred as a result of the historic camping use. This site has been identified for

rehabilitation and will be completed as part of the 2010 State of Michigan ORV Restoration Grant.
Total Area Impacted: ≤ 2 acres.

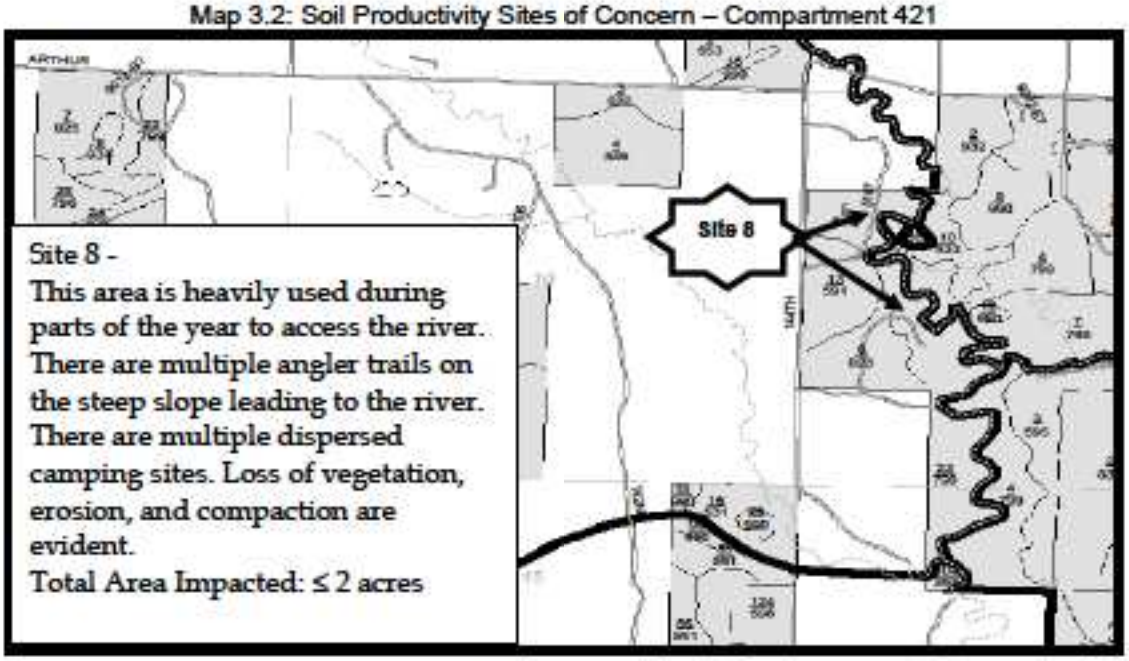
Site 3: There are six separate hillclimb areas associated with this site. Large quantities of soil have eroded and been deposited at the bottom of the slope. This has caused the formation of a land bridge to form across a small oxbow of the White River. The road continues to receive higher levels of use by ORVs than the soils are capable of sustaining, given the steepness of the slope. This site has been identified for rehabilitation and will be completed as part of the 2010 State of Michigan ORV Restoration Grant.
Total Area Impacted: ≤ 2 acres.

Sites 4 and 5: These sites consist of an historic Forest Road and an associated hillclimb. Severe erosion has occurred on the road, which has formed cutbanks upslope and mass deposits of sand downslope. These cutbanks are several feet high and have led to the exposure of entire tree root systems. The road ends downslope at an historic camping area. Site 4 is the hillclimb that is developing from this camping area upslope to connect with the main Forest Road that runs along the White River corridor.
Total Area Impacted: ≤ 1 acre.

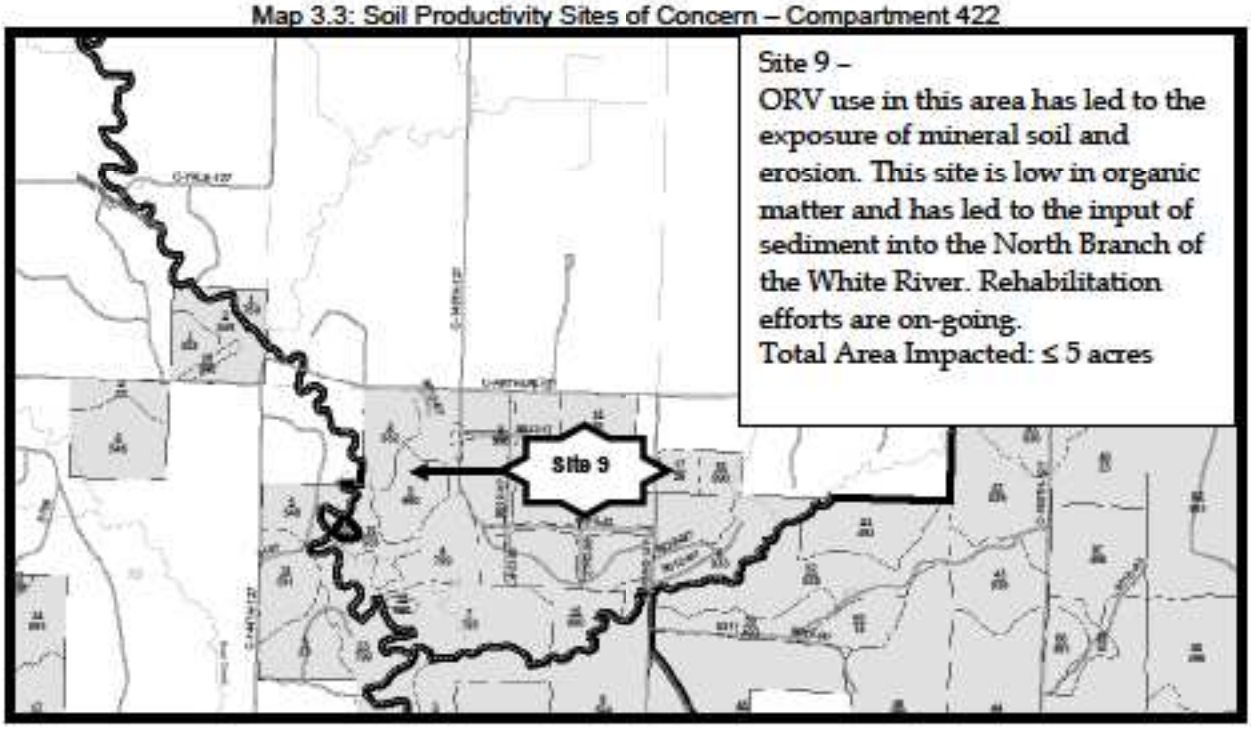
Site 6: This site is referred to as "the bluffs" and is an increasingly high-use area for dispersed recreation. The site is located at the southernmost end of Forest Road 9309 (identified as open on the HMNF Motor Vehicle Use Map (2009). Historical Forest maps indicate that this road dead-ends at a drainage associated with the Main Branch of the White River. The river has more recently altered its course and the road actually now dead-ends at the main branch. The high-use in this area is mainly associated with the sand bluffs which provide recreationists access to the river for swimming, canoeing, etc. The combination of condition and use has led to the mast-wasting of the sandy soil from the bluffs, downslope into the White River. Surrounding the slope to the river there are several dispersed day-use/camping areas where compaction is present.
Total Area Impacted: ≤ 4 acres.

Site 7: This site is locally identified as "twelve rocks" (as discovered during the Scoping process). This serves as a comparatively large area that is highly used by recreationists during the summer months. The banks along the river at this site were previously rehabilitated and large boulders were placed along the river to prevent further degradation (hence the name). There is a road that connects this site with Site 1. The soil at this site consists of exposed mineral soil and there is rutting and cutbanks present along the road that leads to Site 1.
Total Area Impacted: ≤ 2 acres.

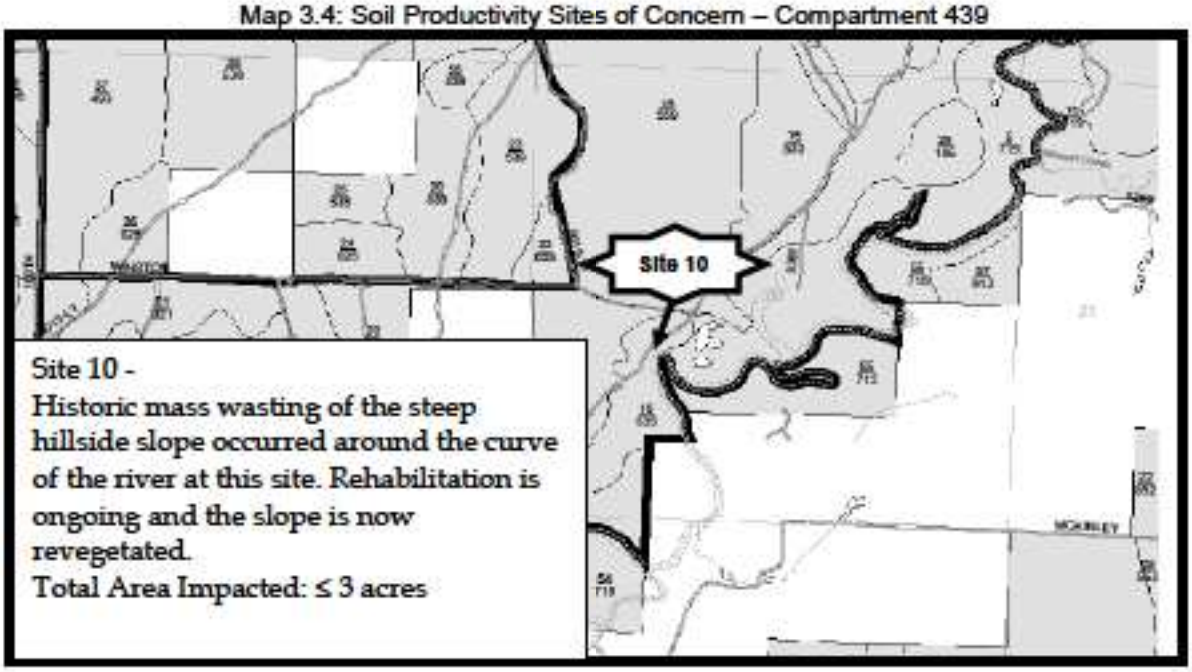
Map 3.2: Soil Productivity Sites of Concern – Compartment 421



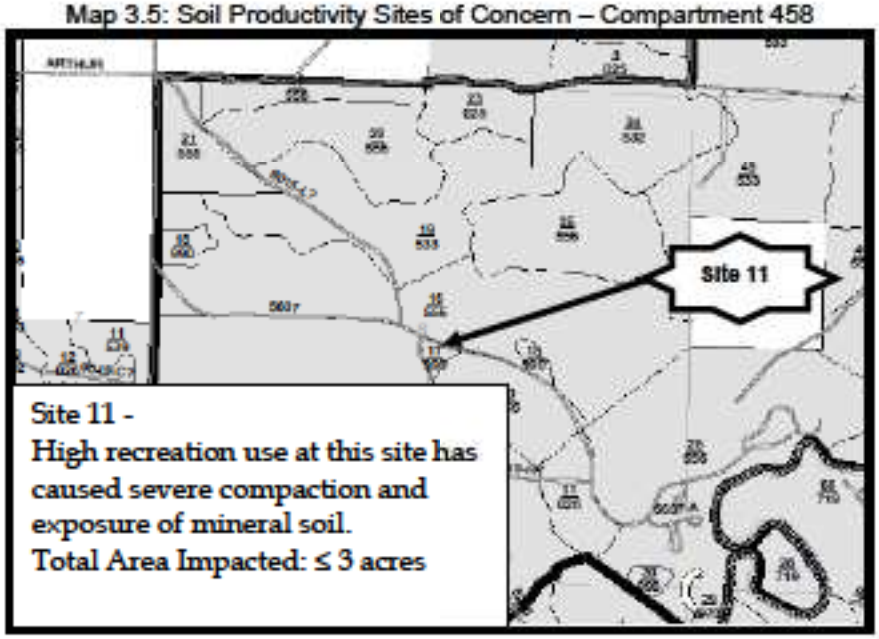
Map 3.3: Soil Productivity Sites of Concern – Compartment 422



Map 3.4: Soil Productivity Sites of Concern – Compartment 439



Map 3.5: Soil Productivity Sites of Concern – Compartment 458



In addition to these sites, soil productivity has been impacted at multiple sites in both the White River and Otto Metapopulation Areas by user-created dispersed camping areas. The level of compaction and the exposure of mineral soil at each of these sites vary by the size, location, and intensity of use. Dispersed Uses (camping, parking, etc.): Dimensions are variable; sites are chosen informally or from prior use; no standards for site protection, and not maintained; used primarily in spring, summer, and fall seasons; open to mixed user group types.

Within the White River Metapopulation Area, there were 38 dispersed camping areas identified. The following describes the parameters that were used to determine the existing size of the different sites:

Small (3 sites): ~ 30′ x 40′ – These sites typically contain enough room to accommodate a passenger vehicle and tent or small pop-up trailer or a truck and small horse trailer for day-use parking.

Medium (16 sites): ~ 40′ x 50′ – These sites typically contain enough room to accommodate one small RV and a passenger vehicle, one large RV, or one truck and small horse trailer for day use parking.

Large (12 sites): ~ 60′ x 80′ – These sites typically contain enough room for one large RV and a large horse trailer or a rig that accommodates both horses and living quarters pulled by a full-size truck.

X-Large (7 sites): ~ 1 acre – These sites typically contain enough room for several large rigs to camp next to each other. These areas are commonly referred to as group campsites.

Based on these parameters, the existing dispersed camping areas within the White River Metapopulation Area are currently impacting soil productivity through compaction and the exposure of mineral soil on approximately 9 acres. Within this area, there are also numerous sites along the White River that were used for motorized recreation/camping prior to the gating of the roads. Restoration activities (i.e. installation of water bars and retaining walls) occurred at the worst sites in an attempt to curtail the deposition of sediment into the river via erosion. Human-related impacts at these sites are now minimal and rehabilitation is on-going.

Existing dispersed camping sites were also identified for the Otto Metapopulation Area. Utilizing the same size parameters identified for the White River Metapopulation Area, the Otto Metapopulation has approximately 19 small sites, 9 medium sites, 7 large sites, and 3 x-large sites. The total area of impact to soil productivity related to these sites is 5 acres.

All of the sites that have been identified are related to the use of motor vehicles, which utilize the existing road system to access these sites. According to the most recent information from the USFS Geographical Information System (GIS), there are approximately 137.3 miles of roads (County, Forest Service, and private roads combined) that currently exist within and adjacent to the Project Area. Assuming an average road width of 12′, there are approximately 200 acres of land within the Project Area existing as exposed or semi-exposed roadbed.

The general features of the transportation system are as follows:

1. Open County roads: Traveled portion of the ROW graded annually, and ROW clearance dimensions infrequently maintained; traveled width 15-40′; maintained principally for high clearance vehicles; used primarily in spring, summer, and fall seasons; open to equestrian uses, OHV use prohibited.

2. Open Forest Service Roads, Maintenance Level 3 (Pines Point access road): Traveled portion paved and clearance dimensions regularly maintained; traveled width 2-lanes; maintained principally for safe travel by passenger vehicles; used primarily in spring, summer, and fall seasons; open to equestrian uses, OHV use prohibited.

3. Open Forest Service Roads, Maintenance Level 2: Traveled portion rarely graded and clearance dimensions not generally maintained; maintained principally for high clearance vehicles; used primarily in spring, summer, and fall seasons; open to equestrian uses, OHV use prohibited.

4. Closed Forest Service Roads, Maintenance Level 1: Traveled portion not graded and clearance dimensions not maintained; maintained principally for high clearance Forest Service vehicles; used primarily in spring, summer, and fall seasons; open to equestrian uses, OHV use prohibited.

Due to the soil types and the seasonally high volumes of traffic, most of the roads within the Project Area consist of exposed and compacted soils having a high sand content. While varying by the site-specific soil characteristics, the areas of lower volumes of traffic typically have less exposure of mineral soil than those areas with higher volumes of traffic. The roadbeds of the existing network currently contain little in the form of vegetation; however on the lower-use roads vegetative strips may occur in the center of the roadbeds. There are some locations where the combination of sandy soils, topography, and mixed use has contributed to the development of road segments that are impassable to passenger motor vehicles due to the depth of loose sand. In other locations, the combination of topography and motor vehicle use has contributed to the formation of deep ruts on slopes and the loss of soil downhill. In some locations, there are several feet of soil that have been transported downslope. This is most evident in the Otto Metapopulation Area (sites 1 through 7 on Map 3.1), as similar sites in the White River Metapopulation have been previously limited to non-motorized use. The loss of soil is considered to be irretrievable.

National Forest Land Suitability

The National Forest lands within the Project Area are generally classified as 1) non-forest, 2) suited for timber production, or 3) suitable for timber production, but proposed for other emphasis. Each forest stand has a land suitability code (LSC) which indicates these classifications. Forested lands suitable for timber management (LSC 500) are planned for long-term timber production, including regenerating to forest in the future. Stands with a LSC of 600 are forested lands that are suitable for timber production, but are proposed for other emphasis that preclude regulated timber production in order to achieve multiple-use objectives. Non-forest land (less than 10% tree cover or developed for non-forest use) has a LSC of 200, and also includes areas of large permanent streams or open water. Lands classified as LSC 700 are physically unsuitable for timber harvest (i.e. due to soils or watershed protection). LSC 800 are lands identified for minimum level management (isolated National Forest land).

Lands in LSC 600 include: 1) Other Emphasis (i.e. savanna restoration), 2) Water Yield Emphasis (i.e. White River Wild and Scenic Study River), 3) Old Growth, and 4) developed recreation sites (i.e. Pines Point Campground). Given the Purpose and Need of this project,

implementation of the Karner Blue Butterfly Recovery Plan, the Land Suitability Classes (LSC) within the Project Area under Alternatives 2 and 3, are shown in Table 3.32, Land Suitability Classes.

Table 3.32: Land Suitability Classes within the Project Area

Compartment	Land Suitability Class (acres)				
	LSC 200	LSC 500	LSC 600	LSC 700	LSC 800
414	147	865	77	0	16
416	143	503	259	0	51
417	42	954	69	0	0
418	203	2158	962	0	8
421	12	483	126	0	21
422	47	227	93	0	0
437	147	1756	334	0	0
438	136	1715	480	0	0
439	132	286	1381	0	2
458	67	599	434	0	57
Total	**1,076**	**8,546**	**4,215**	**0**	**153**
% of NFS Lands in Project Area	7.7%	61.1%	30.1%	0%	1.1%

(3.10b) Area of Analysis

The area of analysis for the direct and indirect effects on soil productivity is the National Forest System lands within the Project Area where vegetative treatments would occur, the specific locations of non-motorized trail designation, existing roads, and the locations where human action or natural processes would be likely to directly or indirectly impact the resource. The area of analysis for the cumulative effects is the Project Area, as the effects on the soils related to this project would be unlikely to reach beyond this boundary and the area is large enough to consider the influences on the soil resources that may be associated with activities on lands that are not under the jurisdiction of the Forest Service.

(3.10c) Direct and Indirect Effects

Alternative 1: The Effects on the Soils Related to the Management of the Vegetation

Under this alternative, there would be no impacts on the soil organic matter related to vegetative treatments. This alternative would result in the highest above and below-ground biomass levels (Pritchett and Fisher 1987). Through the decaying of dead trees and litter fall, carbon would either be released into the atmosphere as carbon dioxide, or become part of the above and below ground biomass soil carbon pools. Increasing soil organic matter would be accompanied by an increase in the relative abundance of soil nutrients, microorganisms, and fungi. There would be a net increase in soil carbon and other nutrient levels as organic matter accumulates within the upper soil profile, undergoes decomposition, and becomes incorporated in the soil profile. This would be the result of natural forest maturation and re-growth, as commercial treatments that would export wood or reduce litter and biomass would not occur. The result of these natural processes is that young forests accumulate soil organic matter at a

greater rate than mature forests, while mature forests maintain relatively higher soil organic matter levels than young forests. Areas converted from forest to non-forest cover types experience a decrease in above ground (deadwood, litter, and humus) soil carbon pools following the reduction of tree cover, and experience an increase in below ground soil carbon pool as the fibrous roots of herbaceous species become established (Brady and Weil 2002). Therefore, as the forested areas continue to grow and mature and herbaceous species become dominant in non-forest areas, soil productivity would gradually increase and recover from previous impacts.

Vegetation treatments associated with mechanical equipment and hand-tool use would occur only in those areas where treatments have already been analyzed and approved. The low intensity of the prescribed fire, mechanical equipment and hand-tool treatments, combined with the short-term effects on soil displacement and fertility, and the continuous or rapid re-establishment of vegetation on these locations have been previously documented in the Savanna/Barrens Restoration Project and Karner Blue Butterfly Habitat Restoration Project. Therefore, the effects of these treatments on the Project Area's vegetation would be local in scale and minor in severity.

There are some locations within the Project Area where vegetation has become re-established on soils that were compacted as a result of historical land use. At these locations, the level of compaction would continue to decrease as soil organic matter accumulates and soil microorganisms reduce the bulk density of the soil and restore water infiltration rates (Brady and Weil 2005). Recovery from compaction would occur over a period of many years, but the long-term effects on sandy soils would be less than in other soils (Stone, et. al. 1999, and Stone 2000).

No herbicide applications would occur under Alternative 1.

Alternative 1: The Effects on the Soils Related to the Transportation System

The current transportation system would remain unchanged. Forest Service Roads that are on the HMNF Motor Vehicle Use Map as currently open would remain open. The existing roadbeds would continue to lack vegetation and susceptible areas would continue to erode, depositing sand in road depressions and increasing downslope accumulations. The existing open roads would not contribute to the production or accumulation of additional organic matter. Expansion of the existing road system would not be likely, as prior road closure efforts have been effective at deterring the development of new user-created roads. However, widening of the existing roads would be likely in locations where soil conditions make specific portions of the roads seasonally impassable due to roughness, high sand content, or puddling. Areas along existing roads would continue to be the most susceptible to erosion, especially where slopes exceed 2%, the ground vegetation is sparse to non-existent, and the amount of vehicle traffic is greatest.

User-developed roads or the roads on National Forest System lands that are not included on the Motor Vehicle Use Map would be subject to closure at any time. Restricting vehicle access in these areas would affect not only the existing roadbeds, but also the locations where dispersed camping occurs along these roads. In these areas, there would be increased levels of organic

matter accumulation. As these areas become revegetated, the level of compaction would gradually lessen due to the penetration of the plant root systems and the soil loosening activities of insects and microbes.

On most roads, micro-topography plays a key role. As the sandy soil from higher spots is washed off by precipitation, it settles in lower elevations. This, in conjunction with the erosive forces of vehicle tire treads, leads to the formation of gullies and wash-outs on some road segments. These areas are present within the Project Area, and would be likely to increase in both size and number, as a result of the "go-arounds" created by users in areas where the existing roadbed is impassable. In addition, the areas of existing OHV damage would remain attractive to users, despite the restriction of this use to designated routes. The continued use by OHVs on sandy soils would continue to create erosion problems in these areas, as the size and number of the locations increases and the soil washes out and moves from areas of higher elevation to areas of lower elevation. On level topography, OHV use would promote the formation of a sand pit, void of all vegetation and susceptible to additional erosion (i.e. Site 9 of Compartment 422, Map 3.3).

Compaction would continue to increase the bulk density of the soils in and along road corridors related to the road traffic and where mechanical equipment is used to complete the three projects that are on-going within the Project Area. The areas affected by compaction would increase at some locations due to the development of by-pass roads to avoid wet pockets in the roadbed and the expansion of unclassified roads off of the managed road system. Activities that promote compacted soils would continue to occur at popular parking locations and along the roads leading into and out of frequently used areas. The compaction on and around the roadbeds may require 40 years for full recovery of infiltration rates (Greacen and Sands 1980).

Alternative 1: The Effects on the Soils Related to Recreation

Recreational activities (i.e. camping) in the Pines Point Campground, and at dispersed locations along Forest and County roads and the White River, would continue to limit permanent vegetative cover and promote increased levels of soil compaction and displacement at these sites. As evidenced by the historical progression of use within the Project Area, the most heavily used dispersed areas would likely continue to expand and new locations would likely become established by users to meet their immediate needs.

Equestrian and pack animal use would continue to be allowed throughout the Project Area and a non-motorized route would not be designated. Consequently, the amount and severity of areas that are entrenched due to the compaction and accelerated erosion related to this use would continue to increase. These effects would be the most pronounced in areas having a high water table, riparian areas, or in locations where this use occurs on slopes. Areas of concern within the Project Area would include Knapp Lake, Knutson Creek, and the slopes that are adjacent to the basins of the North and South Branches of the White River. Corrective action to maintain or rehabilitate areas that have been compacted or experienced accelerated erosion as a result of this use has not occurred. Without such efforts, alternate segments would form in the areas that are heavily used. These alternate segments would likely become similarly impacted by compaction and erosion. Natural processes to reverse and restore entrenched areas would be

inadequate because of the loss of topsoil and organic matter and the corresponding shifts in accelerated runoff and patterns of infiltration.

Equestrian and pack animal use would be expected to be much less in the Otto portion of the Project Area than in the White River Metapopulation Area. However, damage to the soil systems related to OHV use and trash dumping would be likely to occur more frequently in this part of the Project Area because of the fragmented ownership and historical land use patterns. Sites of existing OHV damage would continue to degrade and would likely expand, further displacing top soil and damaging vegetation in surrounding areas. Trash dumping would directly impair soil productivity by introducing pollutants, NNIS, or smothering small vegetation.

Alternative 1: The Effects on the Soils Related to the Restoration of Savanna

Under this alternative, there would be no new restoration activities; however, the restoration activities already approved within the Project Area would continue. Mineral soil would be exposed by mechanical equipment where forests are under conversion to savanna, but not in the other locations where only maintenance with hand tools is allowed. The sandy soils and relatively flat terrain on these sites would result in the exposure and displacement of soil caused by equipment use. This would allow the soils in these locations to be susceptible to the erosive forces of water and wind. This susceptibility would be of short duration. Harvested sites would continue to have a sufficient density of large trees (existing) and herbaceous vegetation (existing or established) to stabilize exposed mineral soil. The acceptable threshold of soil displacement would be ≤40% of any treatment area fo r longer than one growing season, with a maximum sub-location size ≤0.1 acre. Landing sites and skid trails would also be susceptible to erosion due to the exposure of mineral soils in some of these locations. However, if surface infiltration is not impeded by compaction, adequate coarse woody debris is retained, and skid trails have slopes <6%, the erosion hazard potential is slight.

Follow-up treatments at these sites would include post-harvest burning and seeding. Exposed soil would be anticipated as a result of these activities and could increase exposed soil available for transport by wind or water due to the construction of control lines and seed bed preparation. The acceptable threshold of displacement related to these activities would be the same as those identified for timber harvesting activities.

The effects on the soil resources from the activities associated with these projects were considered in the environmental analysis for each of those projects, respectively.

Alternatives 2 and 3: The Effects on the Soils Related to the Management of the Vegetation

The forest and shrub canopy in areas subject to vegetation treatments would be reduced using mechanical harvesting equipment. This reduction in overall canopy cover would alter the existing temperature regime of the soil systems in these locations, causing greater seasonal flux. Seasonal increases in soil temperature would result at the sites where vegetation is removed due to increased direct solar radiation reaching the soil surface. This increase would change the dynamics of biomass accumulation by stimulating organic matter decomposition. Consequently, the thickness of the O horizon would decrease and proportionately more organic

carbon would accumulate in the A and B soil horizons as the herbaceous root mass increases. This change would promote short-term nutrient mineralization that would be lost through leaching if prompt revegetation does not occur (Brady and Weil 2002). The magnitude of these effects would be proportional to the amount of canopy removed, the amount of soil exposed, the existing levels of organic matter at the soil surface, and the site-specific historical impact related to land use (i.e. relatively undisturbed vs. old pasture).

Stone (1999, 2000) has documented the loss of soil productivity on similar harvest sites on the Huron National Forest. When considering the effects of harvesting on soil carbon storage in temperate forests, Nave et. al. (2010) found that carbon stored in the organic horizon (O horizon) of Spodosols (ELTPs 220 – 245) declined more than the carbon stored in the mineral horizons (A and B horizons), and that a period of 50 – 70 years may be required for the soils to recover to pre-harvest levels. These effects were more pronounced in hardwood than in conifer cover types. The on-site retention of the majority of woody material <4" in diameter from harvested trees (slash) in clearcutting units (and a lesser amount of this material in oak regeneration and pine thinning units) reduces this effect on soil productivity. This retention would help maintain above- and below-ground organic matter and provide a substrate for fungi, bacteria, and other micro-organisms in the soil. In addition, harvesting during periods of non-saturated soil conditions and plant dormancy would sustain site productivity by conserving organic matter in litter and root storage in hardwood species (Hallett and Hornbeck 2000). Nutrient cycling processes and organic matter decomposers would mitigate the presence of slash as a hazardous fuel within 5 years of the harvest.

Individual timbered stands would experience an immediate export of site nutrients through the removal of trees. This export would vary in intensity based on the type of harvest (i.e. clearcutting v. thinning). This loss of nutrients would be related to the source/sink processes of the existing vegetation. Nutrients being stored and utilized by the trees at the time of harvest would be lost from the system. In clearcut and overstory removal harvests, this loss would be greater than in the proposed thinnings; however, stand replacement at these sites would occur more rapidly, increasing the ability of the stand to cycle the nutrients available in the upper soil profile. Tree regeneration would be expected to occur the first year after harvest. This, coupled with the extensive root systems left from the previous stand, would reduce the susceptibility of a site to short-term nutrient loss due to the erosive properties of wind and water. In thinning harvests, fewer nutrients would be exported from the system and replacement would occur more slowly through the additive processes of understory development. Skid trails and low standard roads occupy a small percentage of the area, and organic matter removal or relocation would not cause a significant loss of inherent soil productivity.

Compaction would occur on collector skid trails (where more passes occur than are typically associated with only tree felling and loading) and at log landing sites. This compaction would not surpass acceptable thresholds if the increase in soil bulk density remained <15% or the decrease in soil porosity remained <10% (USDA-Forest Service, FSM2509.18). Harvesting during periods of non-saturated soil conditions would minimize compaction of soil macropores and micropores, maintaining aeration and drainage and plant root growth potential (Brady and Weil 2002). As the root systems of felled trees decay, water infiltration would increase due to channeling and would provide increased nutrient and microorganism mobility in these areas. These natural processes would slowly reverse the effects of compaction from the harvesting

activities. In general, thinning activities would result in channeled skid trails receiving higher volumes of harvesting equipment traffic over a single area, compared with clearcut areas where skidding would be dispersed. The length of time for a compacted soil to be restored to its original bulk density depends on the soil texture and degree of compaction. Sandy soils with compacted zones > 6-10" below the surface may require 5-18 years to recover. On sandy soils in lower Michigan, Page-Dumroese et. al (2006) found that soil bulk density on moderately compacted sites varied by depth one year after treatment, with recorded increases ranging from 9- 24%. After five years, the range of recorded increase was 8-17%. Powers et. al (2005) found that after 10 years, soils rarely recovered from severe compaction, regardless of their initial bulk densities.

Appendix A (see General Timber) contains conservation measures to reduce the adverse effects on soil organic matter loss, compaction, and accelerated erosion from vegetation treatments. Therefore, the effects on the Project Area's soil resource would be local in scale and minor in severity.

Alternatives 2 and 3: The Effects on the Soils Related to the Transportation System

The impacts on soil productivity from Forest and County roads, and to a lesser degree from recreation/OHV uses, are associated with soil erosion and the reduced amount of organic matter produced from these non-vegetated areas. The affects on soil productivity by recreational uses are most influenced by a combination of soil texture, topography, and by the type and frequency of recreational activities.

The soil bulk density on closed roads would slowly decrease as the main force of compaction (motor vehicles) would be removed or greatly reduced. As a result, those roads not used for management would begin to sustain vegetation. Penetration of vegetative roots would loosen compacted soil layers over time and promote the natural effects of soil aeration and channeling brought about by worms, insects, and microorganisms. The time to restore these soils within normal ranges would depend on the existing compaction levels, the physical properties, and the type of vegetation re-occupying the site.

Permanent County and Forest roads would also be impacted in the short-term by the traffic from hauling timber products, resulting in periods where increased compaction and rutting would occur on the main haul roads. Temporary roads and landings constructed for timber harvest activities would also remove vegetation, compact soil, and promote the erosion of exposed mineral soil.

Under both of these alternatives, the reduced road density would promote increased soil organic matter accumulation on roads that are closed to motor vehicle use. As evidenced by the presence of old railroad grades on the existing landscape, the majority of roads closed by this project would be evident on the landscape for an extended period of time (50-100 years). However, selected roads within the White River Metapopulation Area would be obliterated, seeded, and become part of the individual management units. The remaining roadbeds of the closed roads not needed for management purposes would be slowly overgrown by herbaceous and woody vegetation. This would promote increased levels of detritus deposits and organic matter, which would provide improved growing conditions for new vegetation in these

locations. Over time, the root systems of this vegetation would serve to increase the amount of the soil organic matter, and thus increase the soil productivity in these areas. Severely damaged areas would not recover within the range of normal soil parameters unless activities to correct site-specific problems (e.g. topsoil replacement) were undertaken. While the soil that has already been lost to erosive forces at these locations would not be re-captured, these rehabilitation practices would allow natural processes to re-vegetate denuded areas. This would reduce additional soil loss and discourage the destruction of additional vegetation. Scarring that has occurred as a result of these activities would remain into the reasonably foreseeable future.

Under Alternative 3, FR9310 in the Otto portion of the Project Area would be closed to motor vehicles, but left open to snowmobiles as part of the West Shore Snowmobile Trail. FR9310 is considered a Level 2 road that receives moderate to high levels of use during the peak recreation season. The traffic from this road would then be re-directed onto to an existing Level 3 road (FR9870/71) to the east. For the latter road to be able to support this sudden increase in traffic there would be substantial reconstruction (clearing, grading, widening, etc.) necessary which would increase the existing footprint of this road. As a result, there would be increased mineral soil exposure, compaction and erosion potential, and loss of vegetation associated with this re-route. However, the result of FR9310 being reduced to administrative and seasonal snowmobile traffic would provide an opportunity for the soils along this route to recover from the historical levels of compaction and mineral soil exposure. Over time, the density of herbaceous and woody vegetation along FR9310 would increase. This would contribute to gradual increases in the organic matter on the soil surface layers and to loosening of the sub-surface layers as a result of penetrating of root systems.

The approximate land area (in acres) that management of the transportation system would have the potential to affect the soil resources is displayed in the following table. The values displayed in this table assume an average road width of 12'.

Table 3.33: Approximate Total Acres of Soils Impacted by the Transportation System on National Forest System Lands within the Project Area (assumes an average road width of 12')

Road Status	Management Area	Road Type	Alternative 1	Alternative 2	Alternative 3
Roads Left Open	Semiprimitive Nonmotorized	FS	11.0	1.0	1.0
		County	11.0	11.0	11.0
	Rural	FS	9.4	8.9	8.2
		County	14.6	14.6	14.6
		Unclassified	0	0.8	0.8
Total Miles			**46**	**36.3**	**35.6**
Total Acres			**67.0**	**53.2**	**51.8**
% of NFS Lands Effected within the Project Area			0.4	0.3	0.3

Alternatives 2 and 3: The Effects on the Soils Related to Recreation

Within the White River Metapopulation Area, the number of dispersed campsites would be reduced from the existing level (approximately 38 sites) to 11 designated sites. Campsites within this area are linked intrinsically to motorized access. Therefore, the reduction in dispersed camping sites would be due to the reduction in motorized access throughout the area.

As the sites that would no longer be available to motorized-dependent camping there would be a gradual decrease in the levels of compaction and an increase in the capacity of water to infiltrate the soil at these sites. The natural accumulation of organic matter on the soil surface, coupled with the soil loosening effects of rooting vegetation, would eventually bring these impacted areas into equilibrium with the surrounding areas where these impacts have not occurred over time. At some locations, it would be expected the existing sites that are currently used for motorized-dependent camping would continue to be used by campers that are not dependent on motorized vehicles.

There are areas within the southern portion of the White River that were used extensively by motorized-dependent recreation in the recent past (5-10 years). While some restoration activities occurred at some of these locations to reduce the input of sediment into the river and to prevent erosion on the slopes, there was little work done to rehabilitate the effects that occurred to the soil systems in these areas as a result of the high levels of use. The type and level of use that was occurring in this area was very similar to that which is currently taking place on the dispersed sites with existing motorized access. The sites without motorized access serve as an example of what would be expected to occur at the sites that are currently open, but would be closed to motor vehicles under these alternatives. The following qualitative characteristics (relative to soil condition) were noted at the southern sites, in comparison to the existing dispersed camping sites:

- Increased levels of leaf litter and organic matter on the soil surface;
- Reduced levels of exposed mineral soil;
- Increased levels of coarse woody debris;
- Increased levels of herbaceous plant establishment;
- Reduced run-off; and
- Reduced trash dumping.

Due to the similarities in soil and vegetative characteristics between these two areas, it would be likely that the sites in the north would exhibit similar qualitative changes if motorized-dependent camping was restricted from these areas.

As the number of existing sites would be decrease under these alternatives, there would be an increase in dispersed motorized-dependent recreational use on the sites that remain and on those that would be developed. All of these designated sites would be adjacent to existing County roads. The level of impact on the soil at these sites would depend on the size of the site. Larger sites would be able to accommodate larger (and heavier) equipment and a greater number of users at any particular time. When compared with the smaller sites, these areas would be more susceptible to increased compaction and reduced water infiltration. In addition, equine enthusiasts have historically utilized multiple locations within the Project Area for group camping. As these alternatives would limit those activities to a few designated areas, the sites remaining would be heavily impacted, especially during the spring, summer, and fall. It is during this time when the soil is most susceptible to the effects of compaction and erosion due to the moisture content and exposure of the surface layer. There would also likely be nutrient spikes to the soils surrounding the larger sites, due the dispersal/disposal of horse manure. While these activities would alter the soil chemistry and nutrient levels at these locations, the effects would be localized and minor in severity.

Based on historical use on the Forest, without containment and enforcement, all of the designated sites would be subject to "creep", as motorized-dependent campers expand the sites into non-designated areas. The large sites would be more prone to these effects, as equine campers tend to seek alternate and multiple places to tether their horses while at camp. This expands the area of soil impact.

Under Alternative 2, equestrian and pack animal use would be confined in the White River portion of the Project Area to a designated non-motorized route. Assuming an average impact area of 48" for this trail, this would directly affect approximately 7 acres of National Forest land. Compaction and accelerated erosion effects would be most pronounced in locations of high water tables and riparian areas, and on non-road locations where the slope exceeds 6%. These effects would be substantially less where the route is coincident with County and closed Forest Service roads. Under this alternative, there would also be a parking area of approximately 2 acres in the northern portion of the White River that would be constructed to facilitate the use of this trail. There would be increased levels of compaction associated with the use of this area for parking; however, the total area within the White River Metapopulation Area impacted by parking would be reduced due to the loss of parking sites that are currently being utilized for recreational day-use. Surface protection would occur at the locations selected for watering to protect the soil resources from accelerated erosion.

Under Alternative 3, a non-motorized trail system would not be established within the White River Semiprimitive Nonmotorized Area, horse use would be prohibited in this area, and the creation of a designated parking area to facilitate this use would not occur. As a result, the impacts related to these uses would not occur.

Under Alternatives 2 and 3, a parking area (<1 acre) would be developed at the eastern terminus of Winston Road within the White River Semiprimitive Nonmotorized Area. This location is currently used as a non-designated parking area and there is an old grade that is open to allow foot travel to the river. Due to the slope and soil types, the existing unimproved parking area consists of deep, loose sand. Activities would occur to harden and protect the surface of this area reducing the potential for accelerated downslope erosion at this site and limiting the compaction to the developed area. As other locations that are currently used for recreational day-use parking would be off-limits (due to the closure of other Forest Roads), there would be an overall decrease to the effects on the soils related to parking under both of these alternatives.

Alternatives 2 and 3 would both allow for other forms of non-motorized recreation (i.e. hiking, biking, non-motorized dependent camping) to occur throughout the Project Area. Based on the current level of this use and the characteristics associated with these forms of recreation, the resulting impacts on the soils would be localized and minor in severity.

Table 3.34: Approximate Acreage of Soils Impacted by Recreation within the Project Area

Source of Impact	Project Area Location	Alternative 1	Alternative 2	Alternative 3
Dispersed Campsites	White River	9.1	0	0
	Otto	4.7	4.7	4.7
Designated Campsites[1]	White River	0	3.6	3.6
Designated Non-Motorized Trail	White River	0	7.2	0
Designated Parking Areas[1]	White River	0	2.5	2.5
Total		**13.8**	**18**	**10.8**

[1]*Does not include features associated with the Pines Point Campground.*

Alternatives 2 and 3: The Effects on the Soils Related to the Restoration of Savanna

As a result of a project previously planned within this Project Area (Savanna/Barrens Restoration Project and the Karner Blue Butterfly Habitat Restoration Project), there would be approximately 474 acres within the Project Area where the seeding of native vegetation and prescribed burning would occur. These acres are in addition to those proposed by the project being evaluated. At some locations, these activities would overlap with the activities currently being proposed. This would be to allow the full suite of treatment options to be available for the restoration or creation of savanna at these sites. Additional sites proposed for savanna restoration under this project consist of upland openings and red pine, white pine, and oak forest cover types.

In the Project Area, the locations where the activities associated with savanna restoration/creation would occur are found on soils with ELTP units 210, 211, and 220. The soils associated with these ELTPs have deep, sandy profiles. The depth to the water table in these ELTPs is >15 feet, and the thickness of the O horizon (fresh and decomposing organic material) in these units is variable, but averages 0-1" thick. The upper soil layers in all of these ELTP units have low nutrient content and cation exchange capacities (Cleland, et. al. 1993). Typically, the highest soil productivity for tree species occurs in ELTP unit 220, and is associated with its comparatively thick layer of humus and a well-defined A horizon (topsoil). Once herbaceous vegetation is established, deep rooted species (e.g., lupine, bluestem, and oaks) exploit subsurface soil layers for moisture and nutrients. The establishment of these species is dependent on the favorable growing-season soil moisture and a mineral seedbed that promotes germination. Pennsylvania sedge and bracken fern compete for moisture in the upper soil layers, and reducing the amount of these two species would be necessary to establish other savanna plant species.

There would be soil compaction from the increased amount of mechanical equipment used to restore the barrens/savanna cover type. Harvesting methods for restoration would facilitate dispersed skidding (except at landings). This would minimize the number of concentrated skid trails within each location. Where compaction occurs on skid trails and landing sites, mechanical site preparation and seeding would reduce the bulk density of these sandy soils by increasing aeration, water infiltration, and herbaceous vegetation recovery. The effects of

mechanical equipment from prescribed burning and the seeding of native plant species would result in short-term soil displacement where prescribed fire control lines are constructed, and where mineral seedbeds are prepared. Fire-line construction would occur on the perimeter of many locations, and be rehabilitated and seeded afterwards using mechanical equipment and hand tools.

The sandy soils, high infiltration rates, and relatively flat terrain of the proposed restoration sites would limit accelerated erosion caused by equipment use to these locations. Treated sites would continue to have a density of large or regenerating trees and herbaceous vegetation sufficient to stabilize, or re-vegetate, exposed mineral soil if the displacement of the forest floor does not exceed 40% of any location, and if any one displaced sub-location does not exceed 0.1 acre in size. Landing sites and heavily-used skid trails would be susceptible to the erosive forces of water due to exposure of mineral soils in some of these locations; however, if surface infiltration is not impeded by compaction, adequate coarse woody debris is retained, and skid trail slopes are <6%, the erosion hazard is slight.

Soil organic matter would be affected by mechanical equipment used for site preparation and seeding of herbaceous species. The effects would be limited to humus disturbance and nutrient mixing within 10–20% of the treated areas, moving organic matter from the O and A horizons to the B horizon, and altering the composition of nutrients available for emerging seedlings (Troeh, Hobbs, and Donahue 2004). Mechanical treatments to expose mineral soil will have small, temporary effects on soil productivity, hastening decay and exposing disturbed areas to small-scale wind erosion. Mechanical site preparation for seeding would be coordinated with strip application of herbicides, particularly where Pennsylvania sedge mats are dense. In situations where mechanical cultivation is necessary, the depth of humic material mixing within the profile would increase. The amount of disturbance would depend on the amount of the residual vegetation and the physical obstacles of each site (e.g., stumps and slash) and the growing requirements of the plants being seeded, but would typically not exceed a depth of 6". Mechanically disturbed sites would be seeded using mechanical equipment and hand tools, and are expected to become fully vegetated within two growing seasons of treatment.

Appendix A contains mitigation measures to reduce the adverse effects on soil organic matter loss, compaction, and accelerated erosion from the treatments related to the restoration/creation of savanna. Therefore, the effects on the Project Area's soil resource would be local in scale and minor in severity.

Prescribed Burning: In addition to the approximately 3,061 acres of burning related to savanna restoration/creation, there would be approximately 1,050 additional acres of burning conducted within the Project Area. The effects of prescribed burning on the soil organic matter in these locations would be influenced by the site-specific soil and fuel moisture levels, fuel loading and arrangement, and the residence time of the fire. These factors are directly related to fire intensity (USDA-Forest Service 2005). In most areas, the desired range of fire intensity would be between 90-300 BTU/ft/sec., with a spread rate of 75'–500'/hour. These intensity levels would be considered light to moderate, but would be sufficient to top-kill the majority of oaks < 2" in diameter at the ground line (Bova and Dickinson 2005). The expected consumption levels of such a fire would be 90+% of the herbaceous vegetation and < 10% of the surface organic

layer. Prescribed fires having this level of intensity on similar sites of the Manistee National Forest have resulted in < 15% mineral soil exposure (Hatting, personal communication, 2007).

There would be an immediate and short-term increase in available nutrients at the soil surface in areas burned at this level of intensity. This spike would occur through the deposition of nutrient-rich ash on the upper soil layers; however, due to pyrolysis and translocation of nitrogen (N) in the humus layer and N volatilized into the air, low productivity sites need to retain substantial amounts of soil organic matter (USDA-Forest Service 2005). This change in nutrient status and chemical status would be of short duration (1-3 years) as the nutrients are used by the existing vegetation, adhere to soil particles, are leached through the soil profile, or lost to transport (wind and water). Despite the combination of low fire intensity and short duration, short-term porosity of the mineral soil would decline where runoff deposits ash and other fine debris in nearby surface depressions (Ibid). Typically, prescribed fires would also increase the availability of calcium (Ca), magnesium (Mg), and potassium (K) via combustion of soil organic matter; N and phosphorus (P) are modestly decreased from volatilization. The majority of soil organic components containing these nutrients are converted into chemical forms that are either readily available to plants or soon lost through leaching. Although in acid soils (such as those found throughout the Project Area), P chemically binds to aluminum (Al), iron (Fe), and manganese (Mn) oxides (Certini 2003). Prompt re-vegetation on areas exposed to prescribed fire would minimize the leaching of N (Pritchett and Fisher 1987). If nitrogen-fixing species are a component of the vegetation re-growth, burning activities may restore the original nitrogen pool in the soil (Certini 2003).

Soil microorganisms have a strong resilience to fire and the re-colonization to pre-burn levels is common. The amount of time required for recovery to pre-burn levels would vary in proportion to the fire severity. Soil microorganisms are most vulnerable to heat damage and habitat changes in the litter and duff, so prescribed burns conducted when the upper layers of the soil are sufficiently dry to carry a surface fire, but moist enough to avoid consumption of the forest floor, humus layers, and soil humus, would ensure a functioning soil biotic community (USDA-Forest Service 2005).

Appendix A (see General Timber and Prescribed Fire) contains conservation measures to reduce the adverse effects on soil organic matter loss, compaction, and accelerated erosion from prescribed fire treatments. Therefore, the effects on the Project Area's soil resource would be local in scale and minor in severity.

Herbicide Applications: The herbicides identified for application in the Project Area (glyphosate, imazapyr, and triclopyr) are known to degrade within the soil profile through various photochemical, chemical, or biological (microbial metabolism) reactions. Herbicides may be immobilized by adsorption to soil particles or uptake by non-susceptible plants. These processes isolate the herbicide and prevent it from moving in the environment. Adsorption is often dependent on the soil/water pH, and generally increases with increasing soil organic content, clay content, and cation exchange capacity. Adsorption is also dependent on water solubility, with less soluble herbicides being more strongly adsorbed to soil particles. Ester formulations are generally the least water solvent, and are therefore more strongly adsorbed by soil particles. In addition, ester formulations are more volatile than salt or acid formulations,

and are therefore more easily evaporated from soil and plant surfaces or leached down into the soil (Tu, et. al. 2001).

The commercial formulation of glyphosate (including the surfactants and inert ingredients) has a benign affect on the microbial community structure when applied at the recommended field rate in forest soils having clay loam and sandy loam textures (Ratcliff, et.al. 2006). There does not appear to be any adverse effects on soil microorganisms from applications of imazapyr when used as an effective herbicide; however, it may persist in soils of arid regions, and does not bind tightly to alkaline soils with low organic matter (Syracuse Environmental Research Associates 2004a). The effects of triclopyr on soil microorganisms suggest that a transient inhibition in the growth of some bacteria or fungi could be expected. This could result in a shift in the population structure of microbial soil communities, but substantial impacts on soil (i.e., gross changes in capacity of soil to support vegetation) would not be likely (Syracuse Environmental Research Associates 2004b).

An herbicide's persistence in the soil is often described by its half-life, or the time it takes for ½ of the herbicide applied to the soil to degrade from its original chemical structure. The half-life can vary depending on soil characteristics (texture, pH), weather (temperature and soil moisture) and the existing vegetation at the application site (Ibid).

Table 3.35 illustrates the interaction that the herbicides proposed to be used have within the soil, and pertains to both Alternatives 2 and 3.

Table 3.35: Herbicide Mobility and Persistence in the Soil[1]

Herbicide	Mechanisms of Degradation	Half-life in the Soil	Mobility
Glyphosate	Degradation is primarily due to soil microbes.	Average of 47 days.	Glyphosate has an extremely high ability to bind to soil particles, preventing it from being mobile in the environment.
Imazapyr	Degraded primarily by microbial metabolism.	1 to 5 months.	Below pH 5, the adsorptive capacity of imazapyr increases and limits its movement in soil. Above pH 5, greater concentrations of imazapyr become negatively charged, fail to bind tightly with soils, and remain available for plant uptake and/or microbial breakdown.
Triclopyr	Rapidly degraded to triclopyr acid by photolysis, microbes in the soil, and hydrolysis.	30 days.	Ester formulation binds readily with the soil, giving it low mobility. The salt formulation binds only weakly in soil, giving it higher mobility (%). However, both formulations are rapidly degraded to triclopyr acid, which has an intermediate adsorption capacity, thus limiting mobility.

[1]*Tu et al., 2001*

These herbicides would be used for spot-treatment of small, dispersed locations of NNIS, strip treatment for seeding site-preparation, and to control the stump-sprouting of recently harvested trees. Application would occur using ground-based mechanical and hand-tools. Specific information related to the use of glyphosate, imazapyr and triclorpyr are documented in Appendix C.

Appendix A (see Herbicides) contains conservation measures to reduce the adverse effects on soil microorganisms from organic chemical applications. Therefore, the effects on the Project Area's soil resource would be local in scale and minor in severity.

(3.10d) Cumulative Effects on the Soil Resources

Alternative 1

The soil resources of the Project Area were impacted in the late 1800s and early 1900s through logging practices, the conversion of portions to agriculture and rangelands, mineral extraction, and periodic fire events. Reforestation efforts, wildlife habitat treatments, and timber harvesting operations also impacted the soils in the Project Area from 1935 to 2009. Since the early 1930s, soil productivity has generally been stabilized or improved. A constant and cycling supply of organic matter has been present throughout the Project Area through the promotion of consistent vegetative cover since the 1930s. This has allowed for the incorporation of leaf litter and the retention of dead and decaying mast. The increase and maturation of vegetative cover over this time period has been accompanied by root growth, which subsequently has increased the sequestration and cycling of nutrients. Generally, nutrients have accumulated in the humic layers or within the existing vegetation. Based on the site-specific soil characteristics, nutrients unused by the vegetation have either accumulated within the upper mineral horizons, or have leached out of the system. The overall effects of the activities that have occurred throughout the Project Area have likely led to increased levels of soil productivity as compared to the 1930s, but reduced levels when compared to the native soil environment.

Live vegetation on National Forest lands within the Project Area would be retained except in the three areas already approved for treatment activities that are on-going. Dead and down timber could be removed throughout the Project Area for use as firewood. In the three on-going treatment areas, there would be reductions in the soil organic matter as a result of red pine removal. At other treatment locations with forest types other than red pine, the treated vegetation will remain on-site or be redistributed within each area. As individual groups of trees, shrubs, and herbaceous species complete their life cycles, general levels of biomass and soil organic matter accumulation would continue to exceed removals. This would result in an overall increase in soil productivity. Timber harvesting activities would likely occur on private property within or adjacent to the Project Area into the future, and would have minimal impacts to the productivity of National Forest System lands. The short-term loss of litter fall from forested areas onto adjacent land would have minor effects to sustaining site-productivity if these private lands remained in a forested, or partially forested, condition.

Currently, areas of eroding and compacted soils occur on Forest Service and County roads and areas that have had timber harvesting activities in the recent past. The effects related to harvesting activities are most severe on the soils receiving concentrated equipment use, such as skid trails and landing sites. Variable amounts of soil compaction, rutting, puddling, and accelerated erosion would continue to occur on areas within the Project Area that are open to motor vehicle and equestrian use. The soils that were impacted by timber harvesting, mechanical tree planting, fire, log landings, and skid trails would slowly recover through natural processes. This natural rehabilitation assumes that damage caused by past management activities have not surpassed the physical thresholds of a given area, and that partial or

complete vegetative cover has been maintained. The most severely affected locations, such as permanent roads and OHV use areas, would continue to be adversely effected unless maintained within designed standards, relocated, or closed and re-vegetated.

Due to the proximity of the Project Area to larger population centers (i.e. Muskegon and Grand Rapids) and the presence of the North, South, and Main Branches of the White River, the Project Area has historically served as a popular location for those that use the Forest for the recreational purposes. The effects of this use on the soils in this area have been described. It is likely that, as the surrounding private lands are further divided and the population increases, the use in this area will. The effects of this are already evident in the Otto portion of the Project Area, where there has been an increase in use as a result of the road closures that have occurred within the White River Semiprimitive Nonmotorized Area. The result has been an increase in new user-created roads and dispersed campsites. In conjunction with these, there would also likely be increases in other recreational uses (i.e. horseback riding and hiking), consumptive uses (i.e. firewood gathering and hunting), and illegal use (i.e. OHV use and trash dumping). The combination of all of these would have a qualitative cumulative impact on the soils within the Project Area.

Within the Project, the soil systems that are associated with the existing riparian areas and stream/river corridors would continue to store larger nutrient levels of carbon and nutrients than surrounding upland areas. This is due to a combination of the historical land use patterns, the existing soil characteristics, and a decreased likelihood that vegetative management activities would occur in these areas.

Conclusion: In considering the past, the present, and reasonably foreseeable future, the duration and magnitude of taking no action would incrementally add to the capability of soil(s) to produce specified plants or plant succession (soil productivity) within the Project Area, primarily by conserving soil organic matter and top-soil, and retaining continuous herbaceous and forest canopy vegetation.

Alternatives 2 and 3

Live vegetation on forested areas would be treated with a variety of management activities; dead and down timber could also be removed for use as firewood. As individual groups of trees, shrubs, and herbaceous species are felled or otherwise complete their life cycles, general levels of biomass and soil organic matter accumulation would continue to exceed removals. In areas that are harvested commercially, the accumulation rate of organic matter on the soils would be less. The retention of slash in these areas would ameliorate loses from stemwood transported off-site. The soil productivity would increase in areas not harvested. There will be fewer acres of land classified as suitable for timber management due to the reclassification of the Land Suitability Class in the areas where savanna restoration/creation is occurring. These areas would no longer be considered suited for timber production. This change would alter the sources and rates of organic matter accumulation to the soil resource by foregoing commercial harvests in some locations, and potentially increasing commercial harvests in other locations.

The savanna restoration activities would alter the soil formation processes where this treatment suite is proposed. Restored savannas would experience changes in soil chemistry and nutrient

cycling different from areas continuously or intermittently in forest cover. The organic matter inputs and accumulation would be concentrated in the mineral soil horizons, instead of primarily in non-mineral soil layers. This alteration to the soil resource would be reversible if reforested again in the future.

With the closure of the Forest roads within the White River Semiprimitive Nonmotorized Area, the county road system in this area would receive more concentrated use by motor vehicles. As a result, there would be increased levels of infiltration, nutrient cycling, and site productivity in the areas closed to motor vehicles and increased levels of compaction, accelerated erosion, and road widening on the county roads remaining open.

Under Alternative 3, the road in Otto Township that would be restricted to public vehicle use would not result in a change to the established levels of adverse soil impacts. Vehicle use on other County roads in Otto and Greenwood Townships is likely to remain the same or increase over time and exacerbate existing adverse soil impacts.

Public interest in utilizing National Forest System lands for motorized-dependent recreation is likely to increase. With the limitations of this form of recreation allowable within the White River Semiprimitive Nonmotorized Area, it is likely that other portions of the Project Area will receive increased use. This would impact the soils through the increased creation and use of existing roads, dispersed camping areas, and non-designated river access sites. The on-going and upcoming restoration projects at the most heavily impacted sites throughout the Project Area, in conjunction with the implementation of the Motor Vehicle Use Map, will serve to reduce most of the soil resource damages related to the changes in recreational use patterns to localized areas of minor severity.

Conclusion: In considering the past, the present, and reasonably foreseeable future, The duration and magnitude of activities included under Alternatives 2 and 3 will incrementally add to the capability of soil(s) to produce specified plants or plant succession (soil productivity) within the Project Area, primarily by conserving soil organic matter and top-soil, retaining sufficient amounts of these elements so that existing soil productivity is sustained following intensive treatment, and by promoting/retaining continuous herbaceous and forest canopy vegetation.

(3.11) Social Resources

(3.12) Recreation

(3.12a) Existing Condition and Resource-Specific Information

Recreation in the Huron-Manistee National Forests

The Huron-Manistee National Forests serve as the "backyard" playground for many Midwest residents. More than 60 million people are within a day's drive of enjoying recreation opportunities on the Forests. Proximity to population centers and accessibility due to road densities makes the Forests popular for year-round outdoor recreational activities. Population growth for the Manistee National Forest impact area (a nine county area) was 15.4% during 1980-2000. Muskegon and Newaygo Counties had the largest absolute growth accounting for 54% of the impact area's growth (Social and Economic Assessment for the Michigan National Forests 2003).

The Forests receive approximately 3 million visits annually (Recreation Demand and Capacity Trend Analysis, Huron-Manistee National Forests 2004). Of these visits, approximately 1 million are distributed evenly between motorized and non-motorized trail use. Overall, the trend for outdoor recreation indicates a continued growth in the demand for opportunities, facilities, and services (Cordell 1999). According to the report by Cordell (1999), the five fastest growing outdoor recreation activities through the year 2050 (measured in activity days) are expected to be: visiting historic places, downhill skiing, snowmobiling, sightseeing, and wildlife viewing.

The recreation niche of the Huron-Manistee National Forests is to provide quality recreational opportunities on nationally recognized rivers, trails, and special areas, motorized and non-motorized trail systems, and some areas where forest visitors have a probability to recreate away from the sights and sounds of human activities. Most lands have features typical of the Roaded Natural class of the Recreation Opportunity Spectrum. Roaded natural areas provide a variety of developed recreation opportunities at campgrounds, water access sites, picnic sites, observation areas, visitor centers and other facilities.

The Huron-Manistee National Forests have qualities and resources that support our recreational niche that include:

- Designated and proposed Wild and Scenic Rivers, the North Country National Scenic Hiking Trail, Lumberman's Monument Visitor Center, Nordhouse Dunes Wilderness Area, River Road National Scenic Byway, and the Loda Lake Wildflower Sanctuary;
- Trail systems supported by a network of partners that assist in the construction and maintenance of motorized and non-motorized trails;
- Blocks of land designated for semiprimitive management that provide areas for recreationists seeking a more remote experience; and
- Camping areas, trailheads, water access sites, and day use areas that support water-based and trail-based recreation opportunities.

The Savanna Ecosystem Restoration Project Area is located in the Semiprimitive Nonmotorized and Rural Management Areas. The Semiprimitive Nonmotorized setting is typified by National Forest System lands which are more remote and not as accessible by motorized vehicles. These areas are characterized by a predominantly natural or natural-appearing environment. Concentration and interaction between users is low. Nonmotorized use is emphasized. Closed roads may be evident and some may be utilized as trails. The Rural setting is typified by National Forest System lands which are less remote than roaded natural areas. Ownership patterns are often scattered with a mix of agricultural lands, private woodlots, and forested National Forest lands. Human activities such as vegetation management, structures, utility corridors, mineral exploration, and development are evident and harmonize with the surrounding environment. Interaction between users is frequent and there are few opportunities to test primitive outdoor skills. These areas are often isolated and near larger population centers, such as Fremont, Muskegon, and Hesperia.

People recreate in the Savanna Ecosystem Restoration Project Area because of the variety of natural resources that are present. The combination of topography, water resources, vegetation, and access found within the Project Area provides a variety of recreational opportunities, both motorized and non-motorized. Some of the recreational uses of National Forest System land that occur include: hunting for deer, bear, turkey, small game, and grouse; fishing; gathering forest products; driving for pleasure; camping; observing wildlife; hiking; horseback riding; mountain biking; canoeing; boating; kayaking; tubing; and snowshoeing and cross-country skiing in the winter. Recreational opportunities in the Project Area fall within the Forests' niche.

Recreation in the Savanna Ecosystem Restoration Project Area

The entire White River Semiprimitive Nonmotorized Area (WRSNA) is within the Project Area. National Forest System (NFS) lands within the area are comprised mostly of large, contiguous blocks. Recreational use, such as dispersed camping, hunting, and horseback riding, is high throughout this area. The majority of the roads under the jurisdiction of the Forest Service are currently or seasonally closed; however, county roads are present and open throughout the WRSNA. Because there are very few open roads, motorized access is limited. There are few blocks of private land and, of these, uses include seasonal residences and forested lands used primarily for hunting. Access to the private in-holdings is maintained via a permit issued by the Forest Service. Firewood cutting is not allowed in the WRSNA, and the harvesting of forest products from NFS lands is generally low.

In the last ten years, use by horseback riders in the WRSNA has steadily increased and signs of that use are evident throughout the area. Currently, there is moderate use of the area by horseback riders (mostly on weekends) involving both trail riding and overnight camping. Organized rides that attract larger groups of riders are becoming more common.

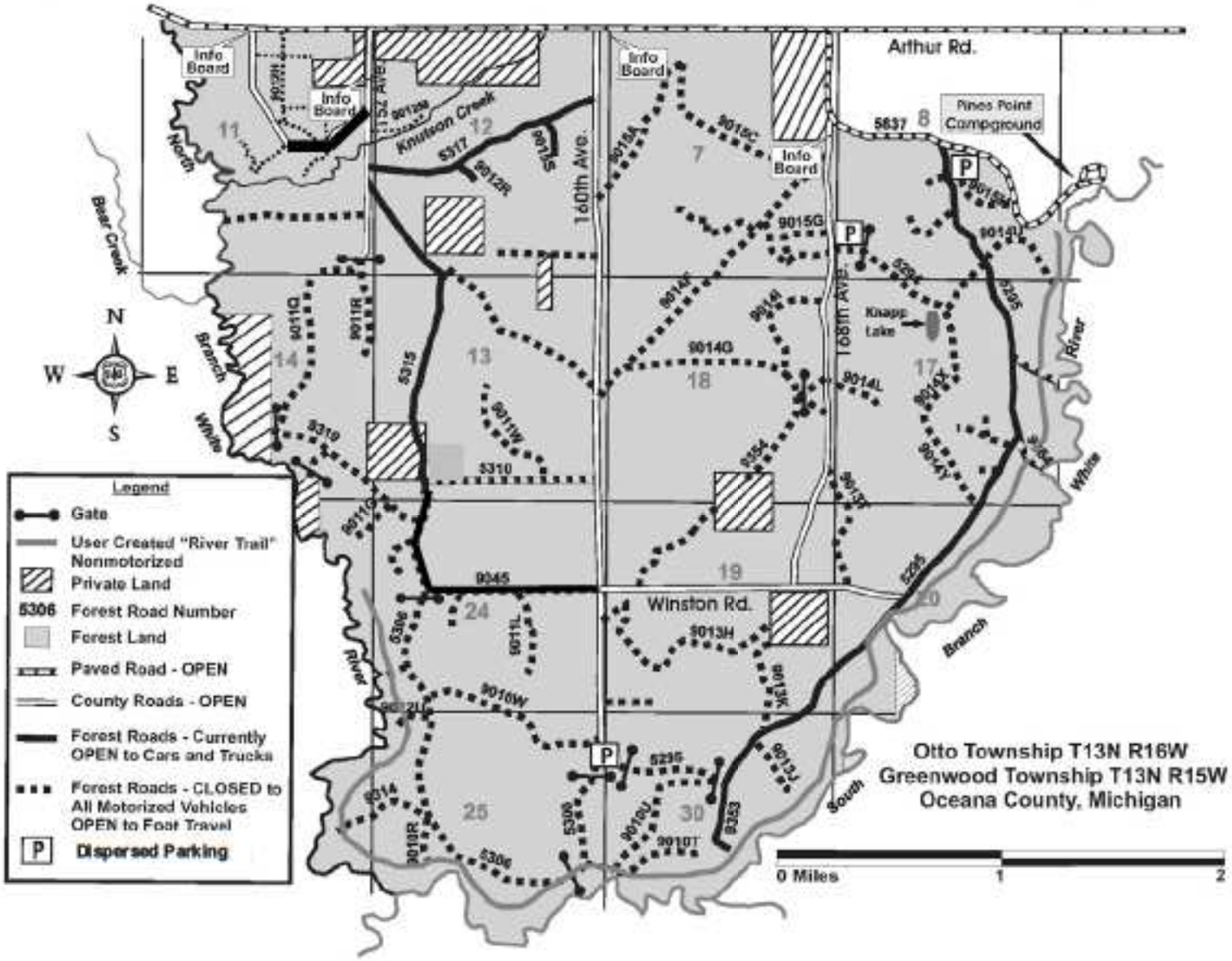
In the WRSNA there is a user-developed parking and camping area in the northeast corner where continuous use has denuded the area of vegetation and created a sand blow-out. Vehicles and horse trailers routinely become stuck in the sand causing the impacted area to increase in size. A system of undesignated horse trails have been created by users throughout the WRSNA. Many of these trails are single lane; however, many people also ride horses on the open forest and county roads. Some of these user-created trails are entrenched and heavily eroded with

areas leading down to the White River for watering horses and crossing the river, causing soil compaction, bank erosion, and vegetation loss. Some trails have also been developed along hills with a slope greater than 20%. The "river trail" has become very popular with horse users. This trail follows the banks of the White River from near the Pines Point Picnic Area to the North Branch of the White River on the west side of the WRSNA. Much of this trail is located in Management Area 9.2, Study Wild and Scenic Rivers. Standards and guidelines for Management Area 9.2 allow for non-motorized trails as long as the qualities for which the river was proposed for study are maintained. See Map 3.6 -Existing Condition and Alternative 1 for the WRSNA.

Horseback riding is also accompanied by RV camping, with many recreationists preferring to camp in groups. This form of camping is also common during the fall hunting season. Most of the camping is currently in open areas adjacent to County and Forest Service roads. Some camping is occurring in occupied Karner blue butterfly (KBB) habitat or in areas proposed for habitat creation. RV camping and horse trailers require large open areas to set up and turn around. These needs have resulted in the development of large dispersed campsites throughout the WRSNA. Currently, there are 38 inventoried user-created campsites in the WRSNA ranging in size from small to extra-large. The total area of soils and vegetation impacted by these campsites is 9.1 acres. Campsite locations and information, such as site dimensions, are shown on Map 3.7 and Table 3.36.

Historically, hunting and fishing have been very popular recreational activities within the WRSNA. Hunters utilize the existing camping areas during the fall deer hunting season. They also use many of the roads and trails for access to their hunting areas. Anglers, however, mostly prefer to use the area by day, utilizing the campsites and pull-offs to park and gain access to the White River for fishing.

Map 3.6: WRSNA Existing Condition



Map 3.7: WRSNA Existing User-Created Dispersed Campsites

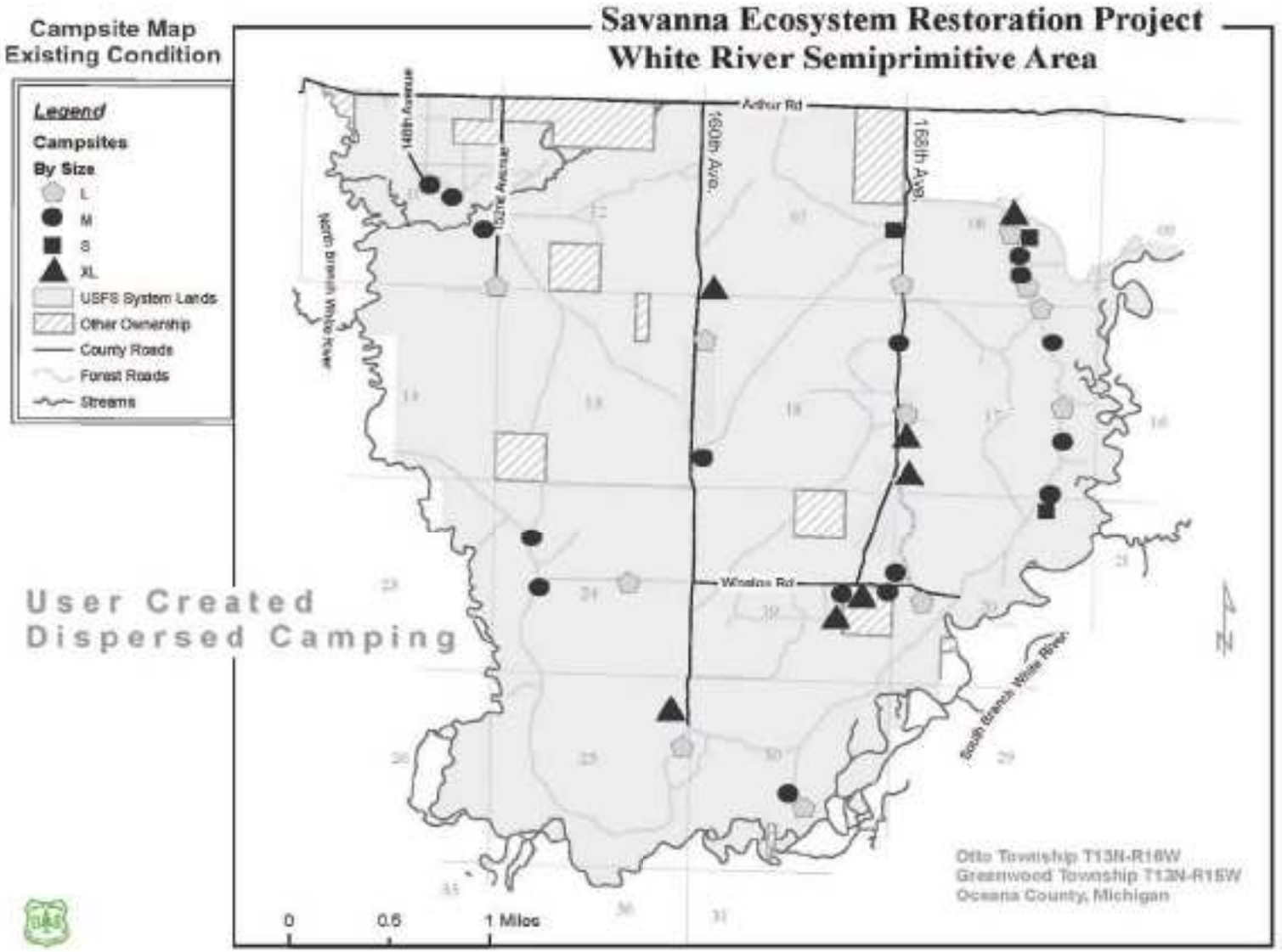


Table 3.36: Existing Numbers and Types of Campsites in the Project Area

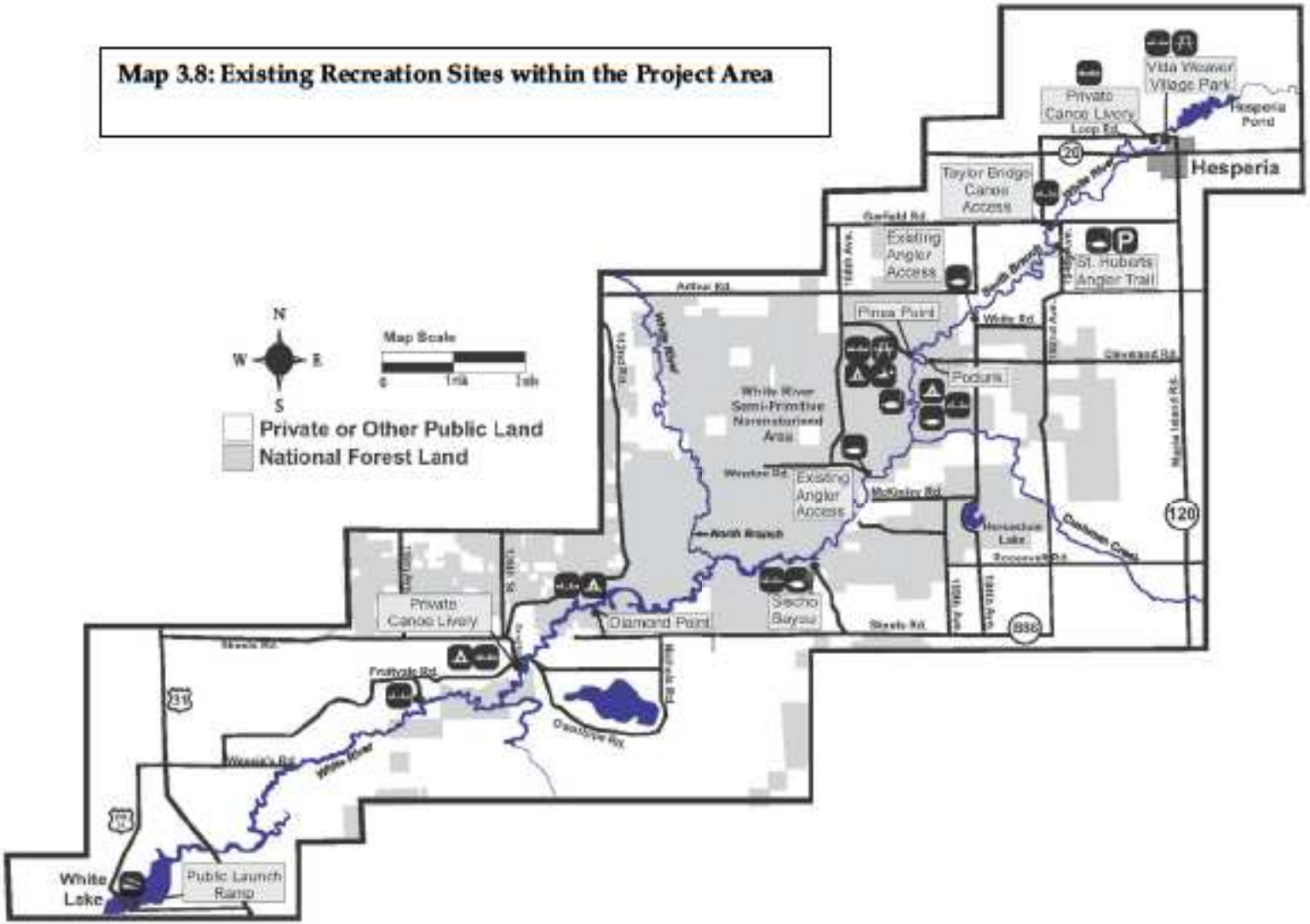
Campsite Type	Campsite Size (feet)	Campsite Area (sq. feet)	White River Area	Otto Area	Project Area Total
Small	30 x 40	1,200	3	19	22
Medium	40 x 50	2,000	16	9	25
Large	60 x 80	4,800	12	7	19
X-Large	1 acre+	43,560	7	3	10
Total Number			**38**	**38**	**76**
Total Acreage			**9.1**	**4.7**	**13.8**

Typically, in semi-primitive non-motorized areas there are few developed recreation sites. There are currently none in the WRSNA, however, there is one adjacent and within the Project Area; Pines Point Recreation Area. Pines Point is a developed campground which has 27 family sites with paved parking spurs, 5 group sites, flush toilets, a carry-in watercraft landing, and a picnic area on the White River. This campground is currently managed under a special-use permit with American Land and Leisure, Inc. There are numerous other developed recreation sites on National Forest lands on the White River, located just outside of the Project Area, that provide access for boating, canoeing, kayaking, tubing, camping, and fishing. These include: St. Hubert's, Podunk, Sischo Bayou, and Diamond Point. These developed sites offer both walk-in and motorized access to the main branch of the White River. Two other river access sites, Taylor Bridge and Fruitvale Road, are located on county land just outside of the Project Area (see Map 3.8). Although none of the sites that are listed are located within the WRSNA, they are directly across from this area and provide access to recreationists floating or fishing the river and areas for camping. The development level and recreational opportunities available at these sites would not change with any of the alternatives included in this project.

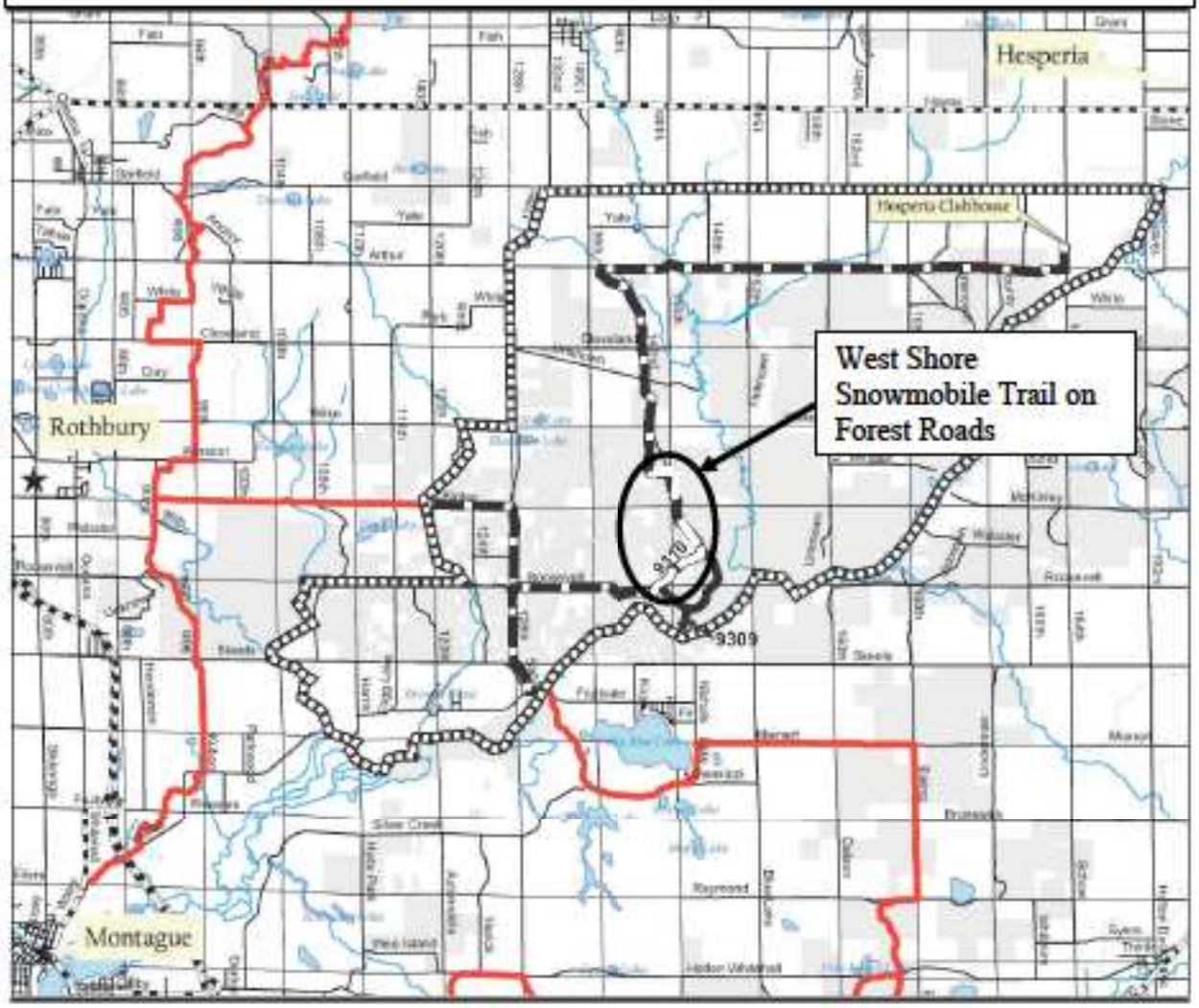
The National Forest System lands within the Otto portion of the Project Area (Rural Management Area) occur in small to medium blocks. There are no developed recreation sites within this portion of the Project Area. Dispersed recreation use, such as camping, hunting, and fishing, occurs throughout this area. There is concentrated use associated with the North and Main branches of the White River which has resulted in several severely eroded and compacted sites. Away from the river recreation use is less concentrated. The National Forest lands are easily accessed by a network of county, Forest Service, and user-created roads. In some areas, roads and concentrated use are occurring in potential or occupied KBB habitat. A total of 15 miles of the West Shore Snowmobile Trail is located on several county and Forest Service roads within the Project Area. The segments on National Forest include a .7 mile segment on Forest Road 9310 and .3 miles on Forest Road 9309 (see Map 3.9).

Private land uses include permanent and seasonal residences and forested lands used primarily for hunting. The hunting of wildlife is one of the top five primary recreational activities on the Forests (Social and Economic Assessment for the Michigan National Forests, 2003). The harvesting of forest products on private lands has been increasing. There is also a moderate amount of firewood cutting by private individuals that occurs within this area.

Map 3.8: Existing Recreation Sites within the Project Area



Map 3.9: West Shore Snowmobile Trail within the Project Area



West Shore Snowmobile Trail within the Savanna Ecosystem Restoration Project Area

Project Area Boundary

Snowmobile Trail on County Roads

Snowmobile Trail on Forest Roads

The hardwood stands located in the Otto portion of the Project Area are ideal for woodcutters because of the proximity to residential areas.

There are currently thirty-eight dispersed campsites in the Otto Project Area (see Map 3.10 and Table 3.36). The existing sites consist of 19 small, 9 medium, 7 large, and 3 extra-large campsites. The total area of impact is 4.7 acres. The restoration of some of these sites will be done in 2012 through a grant from the State of Michigan's Off-Road Vehicle Trail Improvement Fund. The sites included in this grant are user-created and are causing severe impacts to the soil and vegetative resources. Refer to Chapter 3, page 3-126, for a disclosure of effects this impact would have on the soils.

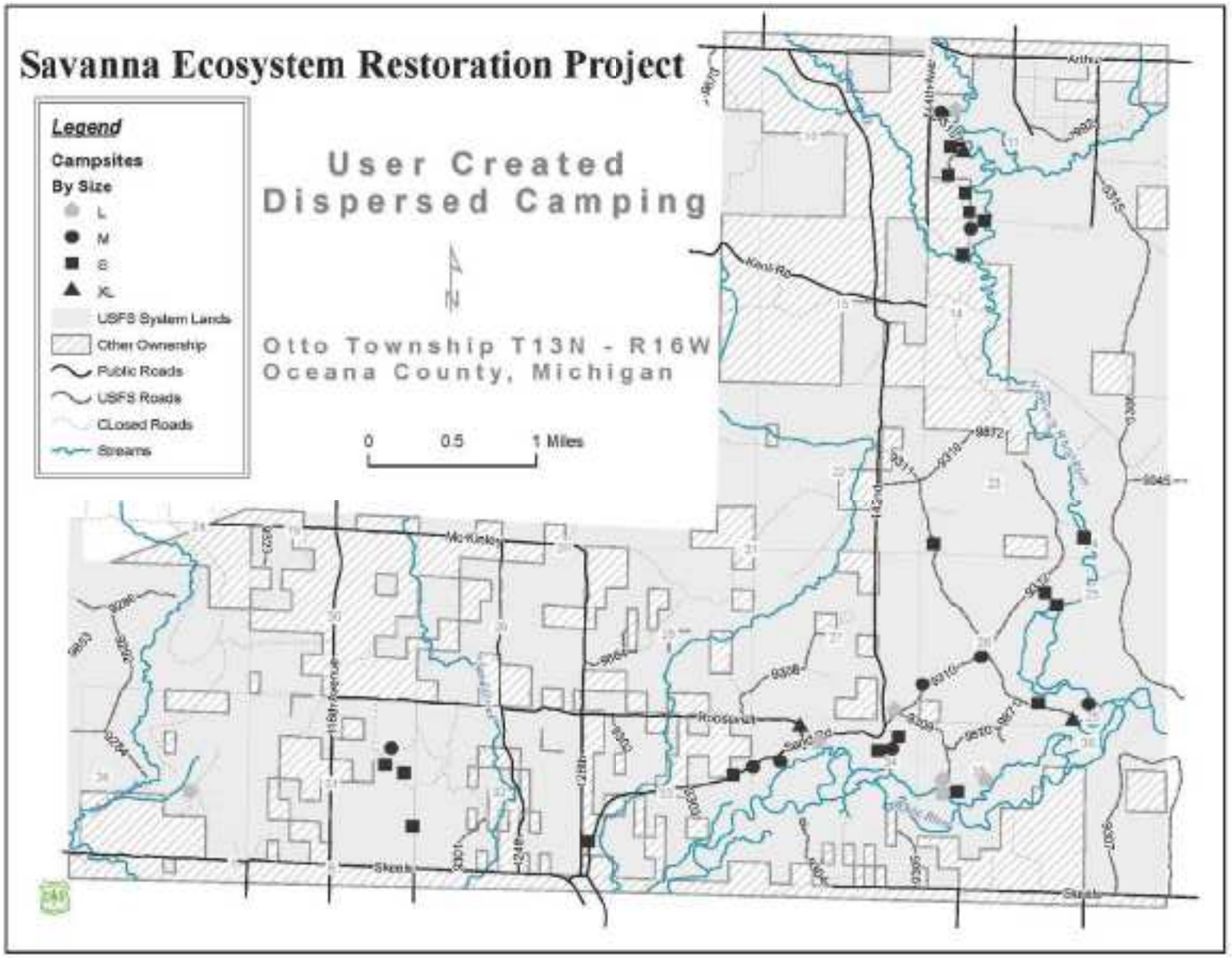
The towns or villages within ten miles of the Project Area include Hesperia, Rothbury, Montague, Whitehall, Holton, and New Era. Recreational use in the Project Area is expected to increase as the population continues to increase. Population growth for the Manistee National Forest impact area (a nine county area) was 15.4% during 1990-2000 (Social and Economic Assessment for the Michigan National Forests, 2003).

There are approximately 137 miles of Forest (classified and unclassified), county, and private roads within the Project Area. There are approximately 46 miles of Forest Service system roads shown on the Motor Vehicle Use Map (MVUM) and county roads adjacent to National Forest lands within the Project Area. In the 6.1 Management Area (MA) there are 22 miles of roads on National Forest lands and 24 miles in MA 4.4.

The scenery of the National Forest System lands in the Project Area is characterized by mostly level terrain with interspersed streams, rivers, lakes, wetlands, and forested stands. These stands include red pine, aspen, and hardwoods. There is an increasing number of semi-open mixed oak savanna areas interspersed within the forested stands of the Project Area, as efforts towards creating KBB habitat have been underway for over 10 years. Areas along the North and Main Branches of the White River are popular with recreationists, as the rolling terrain in these areas offers an increased amount of viewing opportunities.

Undesirable uses in the Project Area (both on National Forest and on private lands) include: trash dumping, illegal cutting of firewood, construction of permanent hunting blinds, and illegal off-road vehicle use. Additionally, within the WRSNA area there is illegal motorized use behind barriers and gates. Trash dumping occurs throughout the Project Area along many of the Forest roads. Recent clean-up efforts by locally organized groups have reduced the amount of trash that is present and the number of dump locations, as compared to the historic levels in this area. Permanent deer blinds are found throughout the Project Area. The illegal off-road vehicle use that is occurring both on National Forest and private lands throughout the Project Area is causing erosion and sedimentation in certain locations, especially on steep hillsides and drainage crossings.

Map 3.10: Existing Condition of User-Created Dispersed Campsites in Otto



(3.12b) Area of Analysis

The actions included in this project that would affect the recreational resources are within the Project Area boundary. Therefore, this serves as the analysis area used for the direct and indirect effects discussion. The analysis area used for the cumulative effects discussion is Oceana County. This area provides a reasonable distance from the Project Area and is sufficiently large enough to display the recreational opportunity types available and how they would be influenced by the changes to the recreational experiences that would occur as a result of this project.

(3.12c) Alternative 1: The Effects on Recreation

(3.12d) Direct and Indirect Effects

Alternative 1 is the No-Action Alternative. Under this alternative, none of the proposed savanna creation/restoration, prescribed burning, timber, herbicide treatments, recreation, or road management activities would occur. Therefore, no direct impacts to recreationists and their use of National Forest System lands related to management activities in the Project Area would be expected. Recreationists would not be displaced during times of management such as prescribed burning, savanna creation/restoration, timber harvesting, or herbicide application. Nor is it likely that recreationists currently utilizing the Project Area would seek alternate areas for use. Those users looking for semi-primitive non-motorized recreation would need to look elsewhere for that experience.

In the short-term, current levels of recreational use would continue with seasonal peaks during summer and the fall hunting months. Recreational use of this area is expected to increase over time as more people move to Oceana County or learn about this area; however, the types and amounts of recreational opportunities available in the Project Area would not change. An increase in acreage of soil compaction, degraded Karner blue butterfly habitat, and non-native invasive plant species would be expected as the size and number of user-developed campsites increased and the user-developed trail system expanded into new areas. Impacts to the water quality of the White River could occur from runoff from campsites and trails/roads located on its banks (see Maps 3.6-3.10).

In the long term, indirect recreational impacts would occur due to a decrease in hunting opportunities for species favoring early successional forests and openings. Areas of non-native invasive species would continue to expand, displacing native vegetation favored by wildlife and potentially effecting species diversity. The occurrence of wildfire may become more frequent and intense, as more people begin to use the area and the areas needing a control burn to reduce fuels would not receive them.

Under Alternative 1, the expansion of the existing road system, especially in the Otto portion of the Project Area, would be expected. This would cause an increase in the potential for trash dumping and impacts to occupied habitat and stream banks. Off-Road vehicle use would continue and new areas of off-road damage, especially along the White River, would likely occur. Current levels of non-motorized uses (such as camping, hunting, and horseback riding) would continue and would likely increase and expand into new areas. User-created campsites

would continue to be developed along forest and county roads throughout the Project Area. The road systems, especially within the White River area, would see some deterioration as more people use the area. This deterioration would be most evident on the roads that receive high levels of mixed use (horses and motor vehicles). No changes to the West Shore Snowmobile Trail would occur.

No human-caused changes to the scenery of the National Forest System lands would occur in this Alternative. Development of private lands is expected to continue with the result being a change in the character of the area from a natural appearing to a more rural setting. Human use and activity would continue to increase on private lands with a potential increase in the encroachment on public lands from private land activities.

(3.12e) Cumulative Effects

Impacts from recreational use and demand for additional facilities and amenities are expected to increase as the population of Oceana County and surrounding areas increases and more people reach retirement age having more time for recreational pursuits. Existing recreational uses of the area would continue and it is likely that new uses would emerge in time. It is expected that for the foreseeable future, horseback riding would continue in the Project Area, particularly in the area of the White River. Occupied and potential KBB habitat would continue to be impacted. Camping and driving for pleasure are activities that would also continue potentially impacting soils, water quality of the White River, occupied or potential KBB habitat, and native vegetation. Users could be affected by their feeling of overcrowding and inability to find places to recreate in a semi-primitive setting. Overcrowding on some of the non-motorized trails could result in a greater frequency of accidents and more severe impacts to the resources on and along the trail system.

The private lands within the Project Area are currently a mixture of permanent and seasonal homes along with undeveloped land. The conversion of seasonal to permanent homes has been occurring at an increasing rate as the population ages and people retire "Up North." This trend is expected to continue in Oceana County with the development of private lands accelerating as people build new homes or convert cabins to year-round residences. Twenty percent of seasonal home owners were "likely" or "very likely" to convert their seasonal residences to a permanent home within the next 5 years and the number increased to almost 30% when the timeframe was extended (Leefers, et. al. 2003). This conversion from seasonal to permanent use will likely increase the number and types of recreationists in this area. More recreationists would result in more impacts to and pressure on public facilities and resources in the Project Area. More use would increase the potential for overlap of users that may be seeking different types of experiences. This would increase the potential for conflict.

(3.12f) Alternative 2: The Effects on Recreation

(3.12g) Direct and Indirect Effects

The number of acres of savanna creation/restoration, timber harvesting, prescribed burning, and non-native invasive treatments is the same for Alternatives 2 and 3. The two action alternatives differ in response to actions related to the recreational use that is occurring,

particularly within the White River portion of the Project Area. Actions related to recreational use under Alternative 2 include: (see Map 3.11)

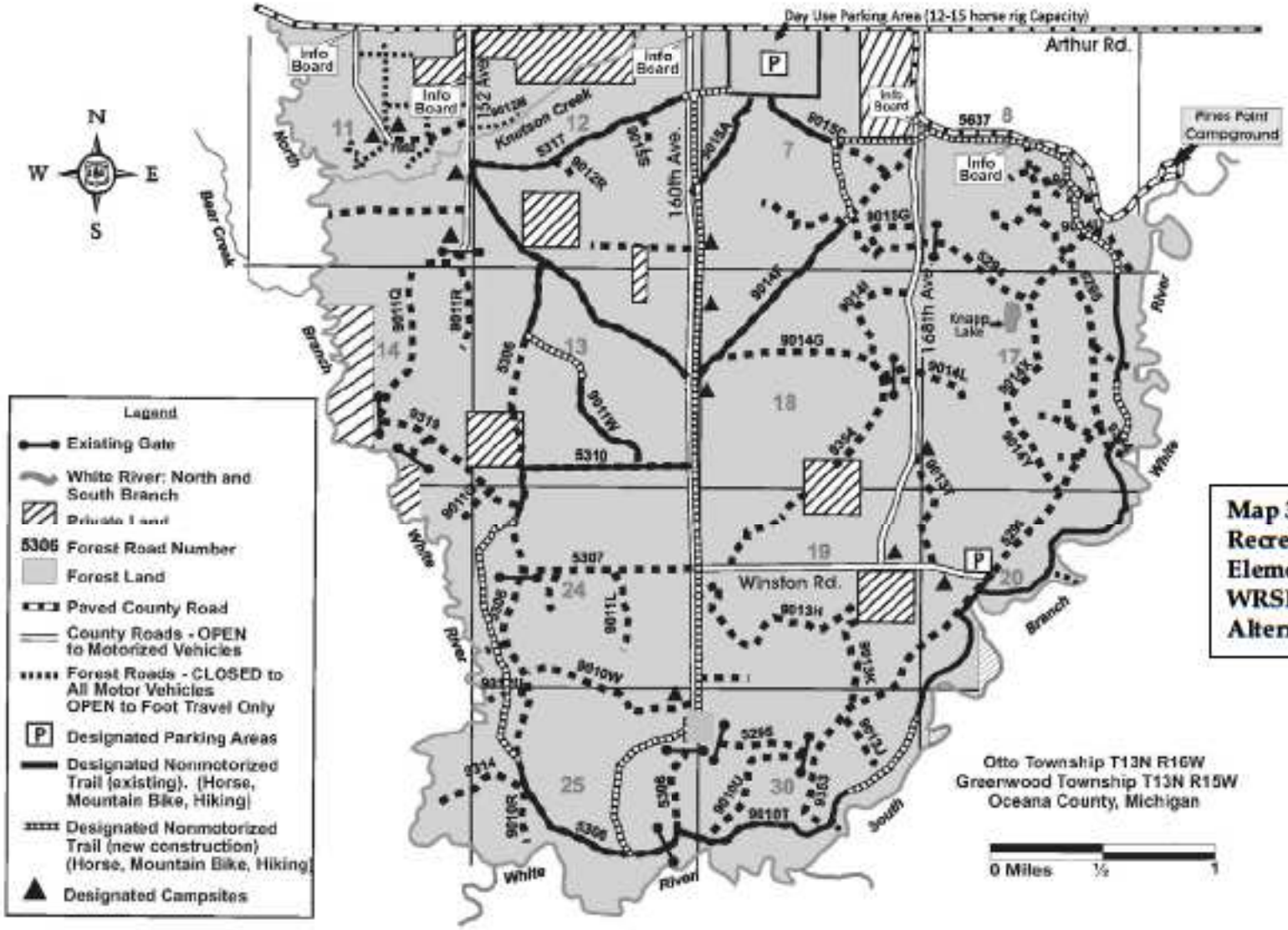
- Complete the road closures in the White River Semiprimitive Nonmotorized Area (WRSNA) by closing approximately 10.0 miles of Forest Service roads. This would limit motorized access in this area to the existing Oceana County road system.
- Designate approximately 19.7 miles of both single and double lane trail within the WRSNA for non-motorized uses, with an emphasis on hiking and horseback riding.
- Develop a 10-15 vehicle and trailer parking area off of Arthur Road for Day Use in the WRSNA.
- Limit watering of horses (using buckets) to identified locations and water sources on National Forest System lands.
- Require the removal of horse manure, feed, and bedding from the designated parking and camping areas.
- Develop a parking area for motorized vehicles at the east end of Winston Road for walk-in access to the White River.
- Designate 11 campsites for motorized camping in the WRSNA.
- Implement a Forest Supervisor Closure Order for the WRSNA that would require that horses remain on designated trail, limit motorized camping to designated sites, and restrict day-use parking for horse use to the designated parking area on Arthur Road.
- Manage the roads in the Otto portion of the Project Area in accordance with the Motor Vehicle Use Map (MVUM 2009) with the following exceptions:
    1. FR9301: This is a north/south road that runs north of Skeels Road and lies west of Sand Creek. All of the property bordering Sand Creek in this area is in private holdings where the road dead-ends and on-going management activities are in conflict with the existing location of the road. This road would be eliminated from MVUM, gated, and put under a Special-Use Permit.
    2. FR9320: This is an east/west road that runs east off of 128th Avenue, before connecting with Kent Road on private property to the east. Under Alternatives 2 and 3 the portion of this road on National Forest System lands would be added to the MVUM.
- Manage the roads in the WRSNA portion of the Project Area in accordance with the Motor Vehicle Use Map (MVUM 2009) with the following exceptions:
    1. FR5295: This is a north/south road that runs along the main branch of the White River. This road would be eliminated from MVUM, gated, and used to access KBB habitat restoration areas.
    2. FR9353: This is a short north/south section of road at the south end of FR5295 that goes to the White River through KBB occupied habitat. This road would be eliminated from MVUM, gated, and used to access KBB habitat restoration areas.
    3. FR5306: This is an east/west and north/south road that runs along the main branch of the White River and goes through occupied KBB habitat. This road would be eliminated from MVUM, gated, and used to access KBB habitat restoration areas.

4. FR5315: This is a north/south road on the west side of the WRSNA. It provides access to two parcels of private property. This road would be eliminated from MVUM, gated, and put under a Special-Use Permit.
5. FR7992: This is a short east/west segment of road in the northwest corner of the WRSNA. This road would be eliminated from MVUM to implement the semi-primitive nonmotorized designation.

Under this Alternative, there would be approximately 2,542 acres of forest converted to savanna over the next 10 years. Savanna creation activities would include partial tree/stump removal, followed by burning, site preparation, and seeding to restore and increase the diversity and density of native plant species. The savanna creation may lead to increased damage from illegal use of ORVs due, in part, to the more "open" appearance of these areas. This may also encourage more illegal dispersed camping. However, these areas would be posted closed to all camping, horseback riding, and other forms of non-motorized activities except foot travel. Mitigation techniques (such as piling brush around the perimeter or the installation of barriers) would decrease the likelihood of illegal activity. Vegetative treatments in the savanna creation areas would present opportunities to educate the visiting public about restoring native plant communities and the recovery efforts for the endangered Karner blue butterfly.

During savanna creation/restoration, prescribed burning, and timber harvesting activities, recreationists would be temporarily displaced. Impacts from burning would be of short-duration and limited to 1-2 days.. Some historic dispersed campsites would be closed in the WRSNA, as all motorized-dependent camping would be limited to designated sites only. Some of these designated camping areas would be less shaded (in comparison to the existing sites) and the sights and sounds of logging/savanna creation and restoration operations would be observed by recreationists for short periods of time. Walking through the vegetation treatment areas would be difficult for the first few years after the completion of treatment activities due to the presence of slash and stumps. In the long-term, there would be an increase in hunting and wildlife viewing opportunities, due to creation of a more diverse forest with openings and improved habitat for game and non-game species. The timber treatments throughout the Project Area would likely be completed in three to five years. However, the savanna creation and restoration activities would not be completed for 10 years, with maintenance activities occurring beyond 10 years.

Under Alternative 2, mechanical, manual, and/or herbicide treatment of non-native invasive species would occur on ~42 acres scattered throughout the Project Area. The infested areas of non-native invasive species (NNIS) are small and generally isolated. The effects of herbicide treatment would be of short-duration and limited to 1-2 days in the early spring. Recreationists may be temporarily displaced during (and shortly after) the time of herbicide application. Natural succession and the re-growth of plants would return the treated areas to a more natural appearance during the next growing season. Temporary visual impacts (such as bare spots) would be expected to last no longer than a single growing season, after which they would be obscured by the native vegetation.



Map 3.11: Recreation Elements in the WRSNA under Alternative 2

Alternative 2 proposes to close ~10.0 miles of roads to complete implementation of the WRSNA designation. This alternative would also leave Forest Road 9310 open year round. Parking and turn-around areas would be provided where roads are closed. Non-motorized activities (such as hunting or hiking) would be allowed in all locations unless posted closed. The proposed road closures would reduce the amount of roads to access the Project Area for driving for pleasure; however, approximately 36.3 miles of Forest Service and county roads would remain open to provide access for recreation activities within the Project Area. Those who use the existing road system to recreate would be directly affected by the closing of roads within the Access within the Project Area by vehicle would be most limited in the WRSNA. Road closures would displace recreationists in the WRSNA, but would provide opportunities for walk-in hiking, backpack camping, hunting, and horseback riding where designated. The concentration of motor vehicle use on fewer roads in the WRSNA would impact those roads left open. They may see an accelerated decline in condition as more people use fewer roads. Some of the closed roads would be incorporated as part of the non-motorized trail system; therefore, having a positive effect on recreation use.

Opportunities for viewing wildlife may increase because of reduced disturbances to wildlife from motorized vehicles. However, there would be fewer areas available for the establishment of motorized-dependent camps within the WRSNA (both hunting and horse-related). Some recreationists may choose to move outside of the WRSNA to other areas that would provide more road access. For example, opportunities in the Otto portion of the Project Area may be more attractive to recreationists (refer to Map 3.10). Safety would increase in the entire area as those roads that are unmaintained, user-created, or are in an unsafe condition would no longer be open. Illegal off-road vehicle (ORV) use would be expected to stay the same or may possibly increase with the implementation of this alternative's transportation system, as riding temptations may be increased where KBB openings are closed. Trash dumping would be expected to decrease through the closure of roads. It is expected that an increase in law enforcement efforts would be necessary throughout the entire Project Area to offset the possibilities of illegal activities.

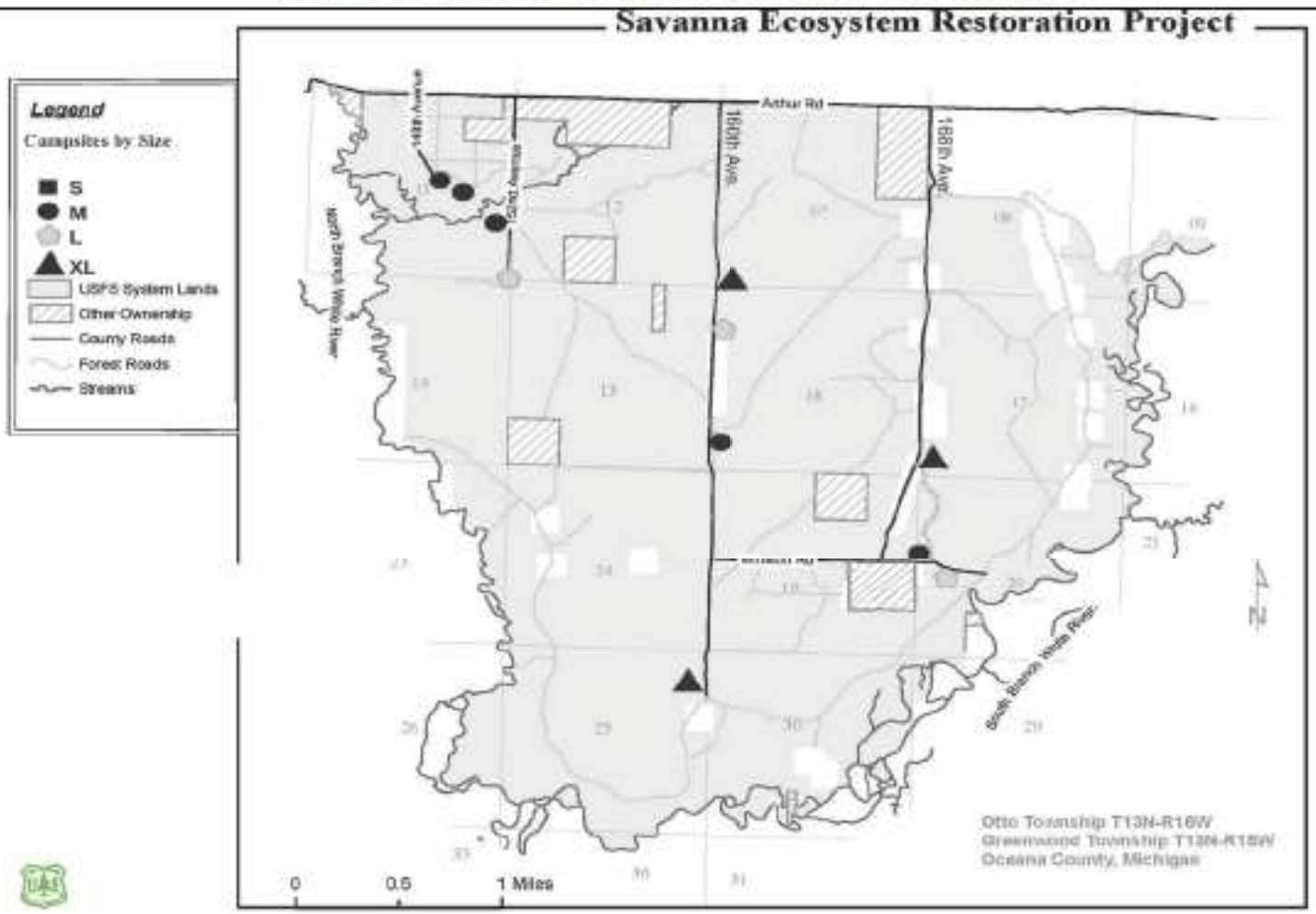
As discussed in the existing condition, the WRSNA in the last several years has become a popular area for horseback riding and camping. The most favored horseback riding trail is the user-created trail along the White River (located partially in Management Area 9.2 – Candidate Wild and Scenic Study Rivers). The designated trail proposed under Alternative 2 would utilize portions of this user-created trail and portions of closed roads. In addition new trail construction would be necessary to parallel open county roads and to develop the trail connectors. Some of the trail would require riders to ride in single file with other stretches allowing for side-by-side riding.

Restricting horseback riders to a designated trail system would concentrate the use in a smaller area than currently exists. This may change the social dynamics of the existing condition. To some recreationists this would be a negative impact as users would see more people on the trail. To those horse riders who are interested in a more "social" experience, this would be a positive impact as they would see more people to potentially socialize with on the trail. Those riders who enjoy "striking out" and riding a different route each time could be displaced to other areas of the Forest or may not ride as frequently in this area.

Concentrating use on a single trail system would likely compact soils, widen and deepen the tread, possibly widen the trail corridor, increase the erosion of soils, increase the amount of manure on the trail, increase the run-off of animal waste into waterways, and possibly increase non-native invasive species along the trail (Pickering, 2009). The combination of trail designation, site design, and the implementation of conservation measures would reduce the impacts from what is currently occurring from unmanaged use in the entire WRSNA. Alternative 2 would provide approximately 12.2 miles of single-track riding and 7.5 miles of double lane riding opportunities where no motor vehicles would be present. This would provide those riders who enjoy the "social" aspects of riding the opportunity to enjoy the company of others while they ride. Overall recreation use may be reduced in the short-term as the existing use is directed to a designated system and day-use parking is limited to the developed parking area on Arthur Road. However, in the long-term more people may use the trail because it would be well-defined and safe (i.e. constructed and maintained to USFS standards). In addition, the development of a map showing the location of the trail system, campsites, and parking areas could increase the recreational day riding in the area. Some users would choose to find other areas on National Forest lands where there are no parking or riding restrictions. They may choose to ride on county roads throughout the project area. This may place increased pressure on the county road system. The impacts of their activities on the road resource itself may become greater. Additionally, the increase in the dual use of both horseback riders and motor vehicles on county and forest roads may result in additional safety concerns.

There are 38 campsites identified in the WRSNA that are currently being used by different groups throughout the year. The majority of the existing 38 campsites are located in, or adjacent to, the treatment units proposed for savanna creation or restoration. This alternative would limit motorized dependent camping to 11 designated sites (see Map 3.12) that are not located in KBB occupied habitat or in savanna creation areas (Forest Plan, II-26 to II-39). The 11 designated sites range from medium to extra-large in size (refer to Table 3.6).

Map 3.12: Proposed Campsites in the WRSNA under Alternative 2



Opportunities for camping within the WRSNA would be reduced, but would remain unchanged in the Otto portion of the Project Area. Riders and hunters that have not been limited in their choice of camping areas in the past could face competition for the larger or more popular sites. A limited number of campsites could result in users "reserving" sites and a need for more law enforcement to ensure sites remain first come first serve. Monitoring of camp site use would occur to determine if there is a need for a more structured system of camp site management. Some users may find alternate places to camp on private and National Forest lands.

To decrease the opportunities for the spread of non-native invasive species, this alternative would require that all horseback riders, both campers and day users, would be required to collect the hay, bedding, and manure from their campsite and parking area and remove it from National Forest System lands (Pickering 2009). This would place an additional responsibility on those who choose to ride horses in the WRSNA. This requirement could displace those users who do not want to have to clean up, which would lead to fewer users on the trails, campsites, and in parking areas within the WRSNA.

Horseback riders would no longer be allowed to take their horses into Knapp Lake or the White River, at any location, for riding or watering their horses. Alternative 2 would limit the locations for watering horses to two designated areas along the White River where horseback riders would be allowed to use buckets to get water for their horses. This action would limit run-off of animal waste into the White River and other waterways, improving water quality (Pickering 2009). This requirement would place an additional responsibility on those who choose to ride horses in the WRSNA. This requirement would displace those users who don't want limitations placed on their activities.

The implementation of the horseback trail designation and the new construction included in this alternative would require the formation of a partnership with a volunteer group (like other trail systems that occur on National Forest System lands). These groups assist in the establishment and maintenance of these systems through a combination of volunteer labor and obtaining the funding that is necessary through grants and donations. The success of implementation would be dependent on finding or formulating this group.

Under Alternative 2, a parking area would be constructed at the east end of Winston Road in the WRSNA for angler access to the White River. This would provide relatively easy access for recreationists to walk a short distance to the river for fishing. Additionally, they may choose to carry-in or carry-out watercraft from or to this location.

Under Alternative 2, the recreation activities which are proposed in the Otto portion of the Project Area would have little impact on recreationists. The vegetative treatments proposed for this area would have the same effects on recreationists as those in the WRSNA. Recreational activities currently allowed, would continue under this alternative. Some limitations on camping may be placed in occupied habitat. Recreational use may even increase in the Otto Project Area as recreationists move from the WRSNA into this area to pursue their recreational interests.

Winter recreation in the Project Area would not change under Alternative 2. There would be no designated snowmobile trail in the WRSNA. The portion of the West Shore Snowmobile Trail that is in the Otto portion of the Project Area would remain open. Winter snowshoeing, cross-country skiing, hiking, and camping would still be allowable recreational activities in both the WRSNA and Otto areas. Access to both areas would remain limited during the winter months. Currently no roads are plowed in the WRSNA and only a few are plowed in the Otto area. No Forest roads would be plowed in either area.

Implementation of Alternative 2 would create more places of solitude for the non-motorized recreationist. Recreationists who fish, hunt, ride horseback, mountain bike, wilderness camp, and hike will find many opportunities to participate in these activities in the WRSNA portion of this Project Area. These experiences are unique on the National Forest as there are few areas available for this type of experience. Consequently, this alternative would displace those recreationists who are looking for a greater motorized recreational experience; however, county roads in the WRSNA would remain open for this type of experience. The Otto portion of the project area would also provide motorized recreational opportunities.

The implementation of MVUM may have the greatest effect on users as it would displace motorized users from the areas where they have historically recreated. Users who drive for pleasure and those who rely on motor vehicles to recreate would be displaced to others area of the National Forest where there would be more motorized access available. This would provide opportunities for forest users to explore new areas to recreate.

(3.12h) Cumulative Effects

The impacts from recreational use and the demand for additional facilities and amenities would be expected to increase as the population of Oceana, and surrounding counties increases. The existing desired uses of the area would continue and it is likely that new uses would emerge in time. It is likely that recreationists may shift their use of National Forest lands from the WRSNA to the Otto portion of the Project area, or other areas of the Forest, where there would be more opportunities for motorized-dependent recreation.

This alternative will provide non-motorized recreationists with a relatively contiguous area of public land to meet their recreational needs. These areas are rare on the Huron-Manistee National Forest and are not currently available in Oceana County. This may serve to draw new users to the county to explore the National Forest. The non-motorized experience would be limited to the WRSNA, as on the other side of the White River there will continue to be motorized access for day use or overnight stays. Motorized opportunities will continue to exist in other portions of the National Forest, as well as at many private businesses on private lands.

The implementation of MVUM will change the recreational use of National Forest System lands throughout Oceana County. Through the process of identifying the official Forest road system, many of the historic roads that have been used by motorized recreationists have been made unavailable for this use. This will place increased pressure on those roads that remain open. Within this Project Area, the loss of the roads in the WRSNA will put more motorized pressure on the roads in the Otto area. With the reduction of available roads in the Otto area due to MVUM, this pressure will be further increased on the roads that remain as part of the official

system. Dispersed sites in this area may see increased user-created damage as more people use fewer accessible areas. The monitoring of these areas will become essential as project implementation proceeds.

Casual observation indicates that there is a rise in the use of horses for recreation on the Forest. On the Baldwin-White Cloud District, this is most evident in the southern tier counties (i.e. Newaygo, Muskegon, and Oceana counties). This use is coinciding with a land base that is becoming more and more fragmented, as larger blocks of contiguous private lands are separated into smaller pieces and sold. The combination of these events promotes an increase in the amount of horse use that occurs on public lands and on public roads (county and Forest). As a result of the activities associated with this alternative, the county roads throughout the Project Area will see increased use by horseback riders over time and the impacts of their activities on the road resource itself will become greater. Additionally, the increase in the dual use of both horseback riders and motor vehicles on county and forest roads may result in additional safety concerns.

Development of private land within the Project Area is expected. Twenty percent of seasonal home owners were "likely" or "very likely" to convert their seasonal residences to a permanent home within the next 5 years and the number increased to almost 30% when the timeframe was extended (Leefers et al. 2003). This conversion from seasonal to permanent use would increase the number of recreationists in this area. More people would result in more pressures on the public facilities and resources throughout Oceana County, and in the Project Area specifically. More use would increase the potential for overlap of users that may be seeking different types of experiences, increasing the potential for user-conflicts. The attractiveness of the WRSNA, the White River, its tributaries, and the "word-of-mouth" spread will likely make this area a more popular place to recreate, therefore, placing additional pressure on the natural resources over time.

(3.12i) Alternative 3: The Effects on Recreation

(3.12j) Direct and Indirect Effects

Alternative 3 would have the same number of acres of savanna creation/restoration, timber harvesting, prescribed burning and non-native invasive species treatment as Alternative 2. Therefore, the direct and indirect effects as they relate to these activities for Alternative 3 would be the same as what has been discussed under Alternative 2. Under Alternative 3, the activities that would relate to recreational use within the Project Area would include the following:

- Complete implementation of the White River Semiprimitive Nonmotorized Area (WRSNA) designation by closing approximately 10.0 miles of Forest Service roads. This would limit motorized access to the existing County maintained roads.
- Prohibit horses in the WRSNA.
- Develop a parking area at the east end of Winston Road for walk-in access to the White River.
- Limit motorized dependent camping to 11 designated sites and limit some forms of cross country travel in specific locations in the WRSNA.
- Manage the roads in the Otto portion of the Project Area in accordance with the

Motor Vehicle Use Map (MVUM, 2009), with the following exceptions:
The roads would continue to be managed according to the Motor-Vehicle Use Map (MVUM, 2009), with the following exceptions:

1. FR9301: This is a north/south road that runs north of Skeels Road and lies west of Sand Creek. All of the property bordering Sand Creek in this area is in private holdings where the road dead-ends and on-going management activities are in conflict with the existing location of the road. This road would be eliminated from MVUM, gated, and put under a Special-Use Permit.
2. FR9320: This is an east/west road that runs east off of 128th Avenue, before connecting with Kent Road on private property to the east. Under Alternatives 2 and 3 the portion of this road on National Forest System lands would be added to the MVUM.
3. FR9310: The segment of this road that is east of 142nd Avenue and west of FR9311 bisects areas that are proposed for savanna creation activities. This segment would be closed to motor vehicles under Alternative 3. It would remain part of the West Shore Snowmobile Trail, December 1-March 15, under both alternatives.

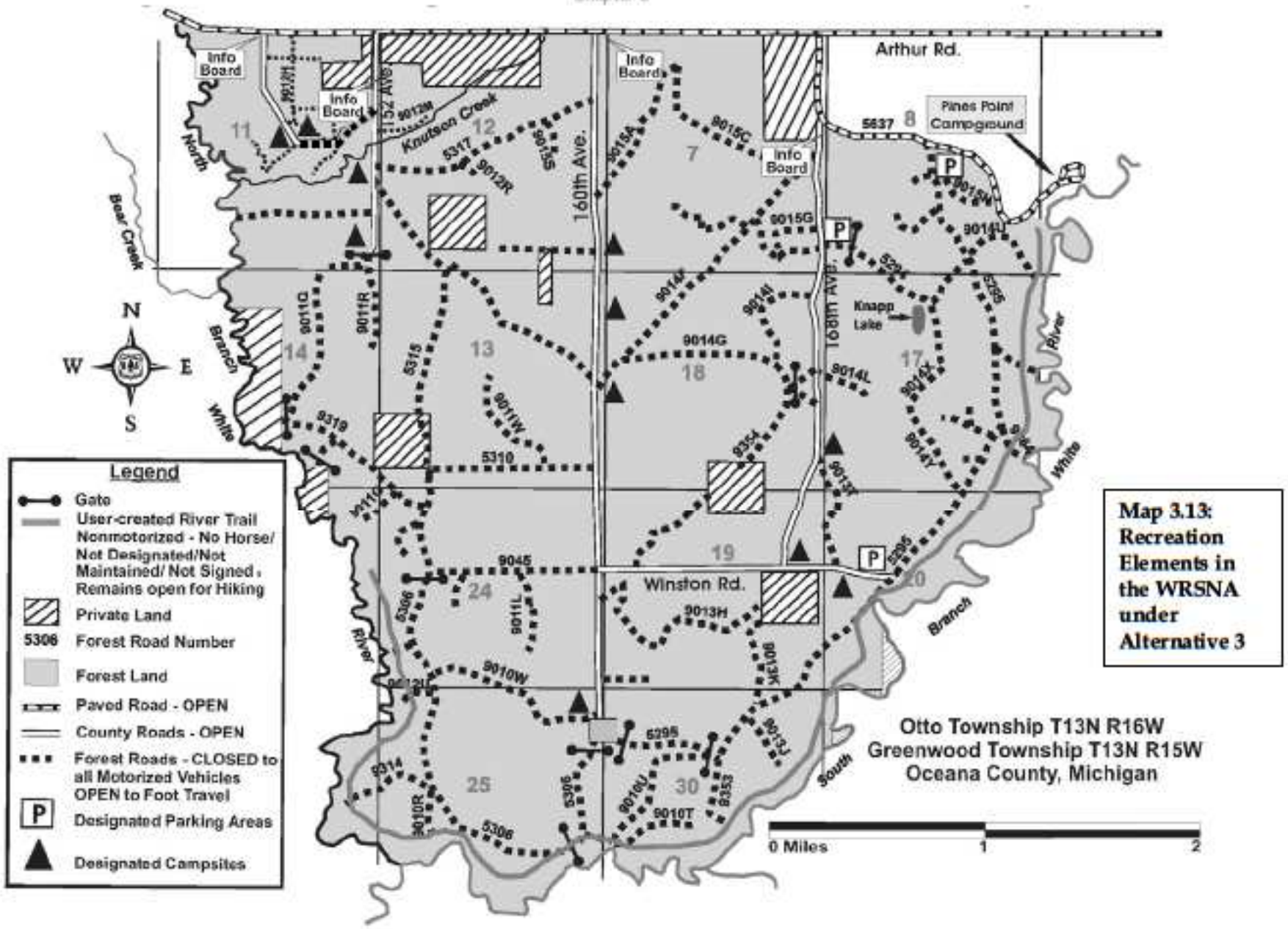
Otherwise, roads currently open on the MVUM would remain open and roads not on the MVUM would be considered closed to motor vehicle traffic.

This alternative would have the greatest negative impact on recreationists who participate in horseback riding and horse camping activities in the WRSNA because it would close the WRSNA to these activities through a Forest Supervisor's Closure Order (see Map 3.13). These recreationists would be displaced to other areas of National Forest with the closest area being the Otto portion of the Project Area. The county roads throughout the Project Area will see increased use by horseback riders over time and the impacts of their activities on the road resource itself will become greater. Additionally, the increase in the dual use of both horseback riders and motor vehicles on county and forest roads may result in additional safety concerns.

There would be no development of a non-motorized trail system in the WRSNA. However, those recreationists who enjoy hiking, mountain biking, snowshoeing, and cross-country skiing would still be able to enjoy these activities in the WRSNA, as well as in the Otto area, in areas not posted as closed. Backpack camping and hunting would still be allowed throughout the Project Area. Motorized-dependent camping would be limited to the 11 designated campsites in the WRSNA, with the effects similar to those described in Alternative 2.

The opportunities to view and hunt wildlife may improve under Alternative 3, within the WRSNA, due to the absence of conflicts associated with horse use in this area. Those opportunities would remain the same or may decrease in the Otto Project Area if recreationists choose to move to this area to participate in their chosen recreation activity.

Alternative 3 would close a 0.7 mile segment of FR9310 to motor vehicles for the snow-off season. It would be open from December 1 through March 15 for snowmobiles as a part of the West Shore Snowmobile Trail System. Therefore, those who use this road to recreate would be directly affected by the closing of this road during the snow-off season. All other road closures would be the same as in Alternative 2 and would have the same effects on recreationists and trail users.



Map 3.13: Recreation Elements in the WRSNA under Alternative 3

Otto Township T13N R16W
Greenwood Township T13N R15W
Oceana County, Michigan

(3.12k) Cumulative Effects

The greatest difference between the cumulative effects of this alternative and Alternative 2 is the impacts associated with removing horses from WRSNA under this alternative. Currently, this area is offers one of the most unique riding experiences on National Forest lands in Oceana County. Those currently using this area for this form of recreation will be displaced as a result of implementing of this alternative.

The demand for additional facilities and amenities in Oceana County and the surrounding counties would be expected to increase with this alternative due to the closure of the WRSNA to horses, horseback riding, and horse camping. Recreationists who enjoy horseback riding would find other areas of National Forest System lands to ride and camp. Many may choose to go to other areas in Oceana County who provide horseback riding opportunities and could support the demand displaced with this alternative. These include: The Double JJ Ranch in Rothbury, the Rainbow Ranch in New Era, and the lands managed by the Michigan Department of Natural Resources and Environment.

It is likely that recreationists may shift their use of National Forest lands from the WRSNA to other National Forest System lands that are adjacent or close to this area where the historic recreational uses would remain available. The areas that are most likely to see this increase in use will be the Otto area and areas along the eastern side of the White River. These areas may also expect to receive the greatest impacts on the resource as dispersed horse camping areas become established in these areas. The impacts (i.e. user created trails and camp sites, non-native invasive species, and water quality concerns) would be expected to increase in this area and other National Forest areas as more people recreate with their horses. County roads will see increased use by horseback riders over time and the impacts of their activities on the road resource itself will become greater. Additionally, the increase in the dual use of both horseback riders and motor vehicles on county and forest roads may result in additional safety concerns.

The dynamics between users in the WRSNA would change over time with the implementation of this alternative. The WRSNA would see marked changes over time as horseback riding is no longer allowed. Non-horse campers, hunters, and hikers would see fewer people with the removal of horse camps and riders. This would allow for more solitude and reduced noise from the sights and sounds associated with horse riding and camping. Early fall hunters would benefit by being exposed to less users in the area at a season when horseback riding is very popular. Likewise, the interactions between these recreational user-groups would likely increase in the areas that are adjacent or close to the WRSNA due to a higher concentration of users. This would likely become less over time, once those displaced from the WRSNA find new locations on both public and private lands to recreate.

Other cumulative effects related to this implementation of this alternative would be similar to those discussed under Alternative 2.

(3.13) Scenery Management

(3.13a) Resource-Specific Information

Landscape Character Elements

Landscape character is a combination of physical, biological, and cultural attributes that give a geographic area its visual and cultural image, and often, unique character. Landscape character represents distinct attributes of landform, vegetation, surface water features, and cultural features that exist throughout the area of interest.

The Project Area consists primarily of glacial outwash plains. Historically, wildfire has played a major role; fires were frequent, and ranged in size and intensity. Fire played a role in savannas by maintaining open conditions where herbaceous species could flourish. The role of wildfire in pine and oak forests served to reduce surface litter and maintain open understory conditions, or less frequently, more intense fires helped to regenerate forests of these species. The less fire-prone sites, including river bottomlands, were less influenced by wildfire, and more by windstorms and flooding as a means of maintaining and regenerating the natural vegetation of maple, pines, and oaks.

Starting in the 1800s, the cutting of the native forests, the establishment of agriculture, and alteration of the natural drainage systems have affected the vegetative patterns in these areas. Red and white pine planting, fire suppression, and the harvest of forests became commonplace after the National Forest was established in the 1930's; private and public land ownership became intermingled. Management of National Forest lands focused on maintaining high amounts of forest cover, and private lands were developed for agriculture. In addition, other elements, such as utility rights-of-way, gas and oil wells, and roads became part of the landscape character.

Classification of Landscape Characteristics

Scenic attractiveness is a way to measure landscape characteristics based on human perception of the intrinsic beauty of landform, water characteristics, vegetative patterns, and cultural land-use. A combination of Landtype Associations (LTA's) and Fire Regimes is useful in classifying scenic attractiveness because there is a high correlation between individual LTA's and the role that fire contributes to the vegetation patterns across large areas. This relationship can be used to assign initial scenic attractiveness into one of three broad scenic attractiveness classes:

Distinctive: Landscapes associated with water features which experienced infrequent to very infrequent stand replacing or community maintenance fires. Examples include the White River, large lakes, and wetland areas.

Typical: Landscapes with some topographical features which experienced relatively infrequent to very infrequent stand replacement or community maintenance fires. Examples include hemlock and white pine forests adjacent to large areas of jack and red pines and savanna.

Indistinctive: Landscapes with level topography which experienced frequent to very frequent stand replacement fires. Examples include extensive areas of jack pine and jack-red-white pine forests, and barrens and savannas.

Measures of Scenic Integrity

Scenic integrity indicates the state of naturalness, or disturbance created by human activities, and is classified as the degree of deviation from the existing condition. There are six scenic integrity levels used to measure scenic integrity in Management Areas (MA) 6.1 and 9.2:

- *Very High:* Landscapes are unaltered with no deviation from the landscape character; landscape character is fully expressed.
- *High:* Landscape appears unaltered, with deviations subtle and not evident; landscape character is largely expressed.
- *Moderate:* Landscape appears slightly altered, with deviations beginning to dominate; landscape character is moderately expressed.
- *Low:* Landscape appears moderately altered, and deviations may be strongly dominant; low expression of landscape character.
- *Very Low:* Landscape appears heavily altered, and deviations may be strongly dominant; very low expression of landscape character.
- *Unacceptably Low:* Landscape is extremely altered, with deviations extremely dominant; landscape character is unrecognizable.

Scenic integrity is also measured using a scenic class index that indicates the value of scenery using a combination of attractiveness, viewing distance, and concern for visibility. There are seven scenic classes used to express scenic integrity in MA 4.4:

- *Scenic Classes 1 and 2:* High public value
- *Scenic Classes 3 to 5:* Moderate public value
- *Scenic Classes 6 and 7:* Low public value

Both methods of measuring scenic integrity are evaluated from existing travel-ways and use areas, using typical on-the-ground observations as the reference and are assessed from four perspectives: historic, existing, interim, and long-term.

(3.13b) Existing Condition

Landscape Characteristics

In relationship to historic fire frequency and intensity, the glacial outwash plains are described in the Forest Plan as:

> *"landscape ecosystems historically experiencing frequent, large, catastrophic, stand-replacing fires. These ecosystems typically occur within very dry, flat outwash plains underlain by coarse textured sandy soils. The dominant forest-type, prior to the mid to late 1800s were short-lived jack pine forests and pine barrens."*

These portions of the Project Area are illustrative of *Indistinctive and Typical* scenic attractiveness classes. They are typical of flatter terrain and are dominated by conifer species.

The Project Area also includes some areas that are influenced by the presence of surface water. In relationship to historic fire frequency and intensity, these areas are described in the Forest Plan as:

> *"landscape ecosystems historically experiencing very infrequent stand-replacing or community maintenance (ground) fires. These ecosystems typically occur within wetlands embedded within or adjacent to fire-sensitive, hence fire protected landscapes. The dominant forest types, prior to the mid to late 1800s, were wetland hardwoods and mixed hardwood-conifer forests including black and green ash, silver maple, elm and cedar."*

These portions of the Project Area are illustrative of *Distinctive* scenic attractiveness. For this project, this includes the areas immediately adjacent to the White River and several isolated wetlands areas.

Scenic Integrity

The existing scenic integrity provides the baseline to develop and transition to long-term scenic goals. The Management Area (MA) standards and guidelines are general descriptors of these goals. Within MA 6.1 (Semiprimitive Nonmotorized), vegetation management is used for improving visual quality, reducing hazard fuels, and maintaining a diversity of wildlife habitats, including old-growth forest development and occupied Karner Blue butterfly habitat. Within MA 4.4 (Rural), vegetation management is used for reducing hazard fuels and managing permanent opening to meet species viability needs, including occupied Karner Blue butterfly habitat.

The pattern of vegetation disturbance, or age-class distribution, is also an indicator of the existing scenic integrity. In general, Table 3.1: Acres of Forest Types by Age Class, 2009, shows that there is a wide variety of upland vegetation diversity, while lowland cover types tend to be older. The 15,000 acres of National Forest System lands represented in Table 3.1 are comprised of approximately 550 unique stands (areas managed for a predominant cover type), averaging 25–30 acres each.

Two additional elements are pertinent to the existing scenic integrity:

1) The frequency/type of roads. These serve as indicators of disturbance, general population, management, and recreational use levels. There are several permanent Forest Service and County roads, and additional closed Forest Service roads with the Project Area.
2) The influence of private land uses within the surrounding National Forest System lands private land holdings. These are also numerous, with the predominant land uses being residential and seasonal residences in forested and woodland settings.

Table 3.37 displays the existing scenic values within the Project Area by MA and Township.

Table 3.37: Existing Scenic Classes

Management Area	Scenic Class	% of Area in Scenic Class
4.4 Rural	1: High	4
4.4 Rural	2: Moderate	8
4.4 Rural	3 to 7: Low	88
6.1 SPNM	1: Very High	4
6.1 SPNM	2: High	10
6.1 SPNM	3 to 5: Moderate to Very Low	86
9.2 Study W&SR	1: Very High	88
9.2 Study W&SR	2 to 5: High to Very Low	12

(3.13c) Area of Analysis

Direct and Indirect Effects: The proposed conversion of forested areas to savannas, and other treatments to forested lands, would produce a noticeable difference in the scenery within and adjacent to the Project Area, and be distinctly different from the forested, agricultural, and rural landscapes. The immediate effects of these proposals are limited to National Forest System lands; therefore, the analysis area for direct and indirect effects from vegetation and transportation treatments is National Forest System land within the Project Area.
Cumulative Effects: All lands within the Project Area are a part of the landscape scenery, although some features are more prominent than others; ownership boundaries are often difficult to distinguish for many visitors. Therefore, all lands within the Project Area are included in the cumulative effects analysis.

(3.13d) Direct and Indirect Effects

Alternative 1

The interim scenic integrity of National Forest System lands would change slowly, affected only by natural events and the three vegetation treatments that are currently active within the Project Area. These treatments include:

- Approximately 50 acres in Greenwood Township that will be converted from plantation red pine to an upland opening and the supplemental prescribed burning, seeding, and planting to restore barren and savanna conditions;
- Approximately 78 acres in Greenwood Township have been converted from red pine and oak to upland openings to evaluate combinations of mechanical and prescribed fire treatments on herbaceous and nectar species; and

- Approximately 346 acres in other upland opening locations within the Project Area will be treated between 2009 and 2011 to maintain open conditions and improve herbaceous diversity.

With the exception of the red pine plantation, all of these treatments are in locations where the tree density is already low. These treatments represent ~3% of the Project Area. The majority of these locations are adjacent to County and Forest Service roads, where the alteration of the landscape is in the foreground. These areas are in MA 4.4 in Otto Township and MA 6.1 in Greenwood Township. Full expression of the reduced tree density and increase in herbaceous ground cover will be not be obvious for 5 – 10 years, but the treatments are essential to restoring savanna conditions and Karner Blue butterfly habitats. Table 3.38 displays the *interim* scenic outcomes within the Project Area by MA and Township.

Table 3.38: Alternative 1: Interim Scenic Class and Scenic Integrity

Management Area	Scenic Class	Scenic Integrity	Township
4.4 Rural	1: High	NA	Greenwood & Otto
4.4 Rural	2: Moderate	NA	Greenwood & Otto
4.4 Rural	3 to 7: Low	NA	Greenwood & Otto
6.1 SPNM	NA	Low - Moderate	Greenwood & Otto
9.2 Study W&SR	NA	High	Greenwood & Otto

Beyond 10 years, the scenic classes (value/interest of scenery) in MA 4.4 would continue to have the existing variety of scenic interest to visitors. The pattern of spatial and temporal disturbances from past tree planting, aspen clearcuts, upland opening maintenance, and road developments would generally provide a landscape of moderate to low interest. Scenic classes of lower interest would predominate where dense, un-thinned plantations and even-aged oak and aspen forests are abundant, and would be interspersed with areas of higher scenic class value where small non-forest areas or larger diameter trees occur. Foreground landscape views would remain fragmented, and opportunities to view desired scenic elements would be infrequent, except where recent savanna creation and restoration treatments were completed. A low expression level of scenic characteristics, such as intermixed forests of oaks, white pine, and other hardwoods, would be common across the landscape. Oak–pine barrens would be small in size and discontinuous, and the potential to provide this distinctive characteristic would decline as tree encroachment overwhelms small non-forest areas.

MA 6.1 would continue to have a limited range of scenic interest to visitors, and the pattern of spatial and temporal disturbance from past tree harvesting and planting, upland opening maintenance, and road developments, would indicate a fragmented, disturbed landscape. The existing scenic integrity of low to moderate would continue, dominated by foreground views of dense, older red pine plantations, younger oak and red pine forests, and even-aged oak forests, interspersed with non-forested areas 3–15 acres in size. Background landscape views would be uncommon, and scenes of the effects of different vegetative treatments and characteristics would be limited to where recent savanna creation and restoration treatments were completed. Forest cover would appear slightly or moderately altered, with a range of age classes occurring mainly in red pine cover types. Deviations or changes in cover types would be abrupt and evident. A low to moderate expression of landscape characteristics (such as oak-pine barrens and areas of intermixed large white pines and oaks) would be infrequent. The potential to

provide distinctive qualities would decline as tree encroachment overwhelms smaller non-forest areas.

The scenic integrity of MA 9.2 would not be affected by this alternative.

Alternatives 2 and 3

Within 5 - 10 years, the proposed actions for savanna restoration, regeneration, thinning, and the management of the transportation system would be completed, along with the on-going treatments. To promote the regeneration of aspen, all of the trees in these units would be removed, save for those that are left for wildlife den, cavity, and roost trees. The two areas proposed for clearcutting consist of mature or over-mature aspen-oak, located in MA 4.4, and further diversify the range of age classes in this cover type. One of these areas is adjacent to the foreground along a permanent Forest Service road; the other is not. Over the course of ten years, these areas would go through three stages: 1) fully stocked mature forest (prior to harvesting), 2) clearcut areas with a few reserve trees and no regeneration present (immediately following the harvest), and 3) fully stocked aspen - oak sapling stand (a few years after the harvest).

There are 21 red pine plantations proposed for thinning. In these plantations, more than 60% of the trees would remain to continue growing. The plantations were established 40+ years ago in rows, usually at high densities. Some of these areas have been previously thinned. First thinnings would consist of removing all of selected rows within a plantation (i.e. remove two rows, leave three rows); second thinnings would remove smaller pines more frequently than larger trees, and retain a high proportion of hardwood species. Some of the plantations are also proposed for prescribed fire after the thinnings are completed. The plantations are located in MA 4.4 and 6.1, and most are adjacent to permanent roads and in the landscape foreground. Evidence of harvest disturbances (i.e. slash, landing and road improvements, and prescribed fire) would be evident for several years. Within ten years, these effects would not be noticeable to the casual observer. Over time, the remaining trees would show increased diameter and crown growth, and the natural regeneration of oaks and red maple would begin to dominate the understory.

There are 56 areas of oak and pine forests that are proposed for conversion to non-forest, (create savanna) or savanna restoration, totaling ~3,061 acres. These areas are either mature or immature forested stands, located in MA 4.4 and MA 6.1, with the majority being adjacent to permanent roads and in the landscape foreground. Timber harvests and other activities (including prescribed fires) would retain 20-25% of the pines, oaks, and other woody vegetation to provide partial shade, and be left as either individuals or in small groups. Post harvest and prescribed fire treatments include seeding and planting to supplement the natural regeneration of the desired herbaceous and woody flora. The full expression of the reduced tree density and increase in herbaceous ground cover will be not be obvious for 5 – 10 years, but the treatments are essential to restoring savanna conditions and Karner Blue butterfly habitats.

Prescribed burning is proposed for ~ 1,050 acres that are not included in the activities discussed above. Most of these areas are adjacent to permanent roads and in the landscape foreground. Fire scorch would be evident on the larger stems, and smaller diameter woody understory

species would be killed. Prescribed burning would begin to return these areas to the desired Fire Regime class, with forested areas having a reduced understory canopy. Prescribed fire in these areas would facilitate meeting the objectives of restoring savanna and Karner Blue butterfly habitats by increasing treatment efficiency and providing better public and resource protection. Within ten years, different areas would likely have received a different number of prescribed burns of varying intensities.

There are Forest Service roads within the Project Area that are proposed for closure to motor vehicle use by the general public. All county roads would remain open to motor vehicles.. Evidence of the existing roadbeds, clearing limits, gates and barriers, and parking areas would remain in the next 5–10 years in all locations. Some locations would recruit woody vegetation that would reduce the visible effects of past use, but the impression of "ready access" would remain a part of the landscape's character.

The combination of these activities would result in the interim scenic outcomes displayed in the following table.

Table 3.39: Alternatives 2 and 3: Interim Scenic Class and Scenic Integrity

Management Area	Scenic Class	Scenic Integrity	Township
4.4 Rural	1: High	NA	Greenwood & Otto
4.4 Rural	2: Moderate	NA	Greenwood & Otto
4.4 Rural	3 – 7: Low	NA	Greenwood & Otto
6.1 SPNM	NA	Low - Moderate	Greenwood & Otto
9.2 Study W&SR	NA	High	Greenwood & Otto

The long-term scenic integrity objectives for all MA's are established in the Forests' LRMP Standards and Guidelines.

Management Area 4.4: This MA uses scenic class to measure the public value of National Forest scenery, based on a scale of high = 1, to low = 7. Scenic classes are determined by combining scenic attractiveness classes with distance zones and concern levels of the landscapes' visibility. Thus, in MA 4.4, there is a sensitivity level range of scenic class objectives, indicating that a range of vegetative treatments is expected, and that a range of viewer interest exists. Generally, scenes of the highest interest are the most sensitive to change, such as foreground vegetation clearcuts (i.e. along high use roads and trails). Conversely, scenes of lower interest are less sensitive to change, such as background clearcuts (i.e. visible through other vegetation from high use roads and trails).
Management Areas 6.1 and 9.2: These MA's are assigned scenic integrity objectives in the Standards and Guidelines, which guide the amount, degree, intensity and distribution of treatments needed to achieve desired scenic conditions.

Beyond 10 years, the scenic classes (value/interest of scenery) in MA 4.4 would have a wider variety of scenic interest to visitors. The pattern of spatial and temporal disturbances from past tree planting, aspen clearcuts, upland opening maintenance, and road developments would be less common, and relatively large oak–pine barrens would provide areas of higher viewer interest along County roads. Fewer areas of dense, un-thinned plantations and even-aged hardwood forests would occur, and would be interspersed with larger areas of different scenic class value. Foreground landscape views would be less fragmented, and opportunities to view

desired scenic elements would be more frequent, as areas of oaks, pines and aspen attain more open conditions. A higher level of expression of desired landscape characteristics, including canopy diversity and larger diameter trees in pine plantations, and a wider variety of herbaceous species in open areas, would be more common across the landscape. Oak–pine barrens would be larger in size and take on natural configurations, and the potential to provide these distinctive characteristics would increase as prescribed fire is more easily and efficiently used.

MA 6.1 would have a wider range of scenic interest to visitors; a more natural appearing landscape would begin to replace the historical pattern of spatial and temporal disturbances. The fragmented landscape of forest and open areas would become consolidated as relatively large areas of oak forests of different age classes attain oak–barren conditions. Fewer areas of dense red pine plantation would occur, and non-native Scots pine would be removed. The scenic integrity would be changed, primarily because the frequency of abrupt cover type boundaries would be reduced. Foreground views of dense, older red pine plantations, younger oak and red pine forests, and older even-aged oak forests, would be interspersed with large non-forest areas. Background landscape views would be common from Forest Service (open to nonmotorized uses) and County roads. Forest cover would appear slightly or moderately altered, with a range of age classes occurring mainly in red pine cover types. Deviations, or changes in cover types would be less abrupt and evident as the oak–pine barrens assume a larger proportion of the landscape. A higher level of expression of landscape characteristics (such as oak-pine barrens and areas of intermixed large red pines and oaks) would be found. The potential to provide these distinctive characteristics would increase as prescribed fire is more easily and efficiently used.

Visual elements of the prescribed fire activities would be evident, and decrease in prominence with each fire application. There would be reductions in the amount of forest litter present and increases in the presence of the native understory species (grasses, forbs, and sedges) in oak–barrens areas. Fire scar on larger trees in these areas would persist and become prominent after each prescribed fire treatment. Therefore, there would be an increase in this characteristic landscape element of LTA 1.

The scenic integrity level would appear moderately to slightly altered following conversion of forested lands to savanna. The roadbeds of County and Forest Service roads would also give the impression of a landscape influenced by human activity. When the proposed activities (i.e. seeding, hand-cutting, prescribed burning, etc.) to establish a diverse herbaceous cover in the restored savannas are completed, the deviations of the existing landscape would be evident, but less dominant, as evidence of the tree cover diminishes and the herbaceous flora matures and becomes more dense. The desired landscape characteristics of prairie grasses and forbs, especially wild lupine, and large oaks would become common, and generate a moderate amount of landscape unity.

The scenic integrity of MA 9.2 would not be affected by this alternative; all proposed treatments are outside of the boundary of the candidate Wild and Scenic River corridor along the White, or so located as to have no effects on its landscape characteristics.

(3.13e) Cumulative Effects

Common to All Alternatives

The scenery of the Project Area is dominated by the vegetation on National Forest System lands, except along Garfield, 116th/Fogg Lake, and Fruitvale roads, where agriculture and recreational/residential development occurs. Privately owned lands adjacent to National Forest System lands proposed for treatment are primarily forested, with some areas of non-forest and low tree cover density.

Implementing the Forests Plan Desired Future Condition would affect the scenic integrity objectives in the Project Area primarily by preserving the corridor of the White River (including the North and South Branches), promoting old-growth forest characteristics in riparian environments, and providing habitat suitable for the Karner Blue butterfly. The latter objective would likely convert additional forest area to savanna, especially in Greenwood Township, Sections 7 and 18 (MA 6.1), and Otto Township Sections 20, 27, 28, 29, 31, 32, 33 (MA 4.4). The conversion of these areas to savanna would include the suite of harvesting, non-commercial woody vegetation control, prescribed fire, and the seeding/planting of herbaceous species proposed in this project. Karner Blue butterfly habitat restoration efforts in the next 10–20 years may create 50% more oak barrens than the amounts proposed in this project. Timber management in pine plantations, aspen, and oak forests may affect several thousand acres over the next 20+ years, through a combination of thinnings and regeneration harvests. The density of County and Forest Service roads, and the maintenance level of Forest Service roads, is anticipated to remain static over the next 20+ years.

Alternative 1

The distinctions between the vegetation patterns of private and National Forest System lands would be relatively small. Approximately 6-7% of the landscape would appear more open and management activities would occur to maintain open canopy conditions. In these areas, prescribed burning activities would serve to stimulate the seedbank of the soil and promote the appearance of new species of grasses, forbs, and sedges, and leave evidence of each treatment (i.e. fire scar, small tree mortality). The forested areas of National Forest System lands in MAs 4.4 and 6.1 would remain in the existing scenic condition, with few expressions of the desired landscape elements. These elements would be fragmented across the Project Area. The scenic objective in MA 9.2 would not be directly affected, and the potential to contrast the characteristic landscape elements among MAs with Alternative 2 would be subdued.

Private land management within the Project Area would reflect landowner objectives, parcel size limitations, and legal requirements. Productive agricultural lands are likely to remain dedicated to this purpose. Smaller parcels, especially in wooded settings or where local zoning authorizes commercial uses, are expected to follow general social-economic trends and would likely be further developed. Under this Alternative, the scenic distinction between private and National Forest System lands would be the greatest.

Conclusion: The duration and magnitude of no action would not incrementally add to past, present, and reasonably foreseeable scenic integrity objectives within the Project Area. Mature oak and aspen forests would be retained, except where non-forest habitats already exist, allowing other hardwood and conifer forests to mature or be replaced by late-seral stages of

forest vegetation. This effect would be most pronounced on National Forest System lands. Private lands are expected to shift towards building site development and recreational uses, woodlands, and upland open uses (i.e. unimproved pasture and game species habitat improvement).

Alternatives 2 and 3

The restored savannas would partially meet the scenic integrity objectives in each MA of the Project Area, and serve to differentiate the habitat goals of private and National Forest System lands. Areas that are now heavily forested would appear more open and management activities would occur to maintain open canopy conditions. Prescribed burning activities would serve to stimulate the seedbank of the soil and promote the appearance of new species of grasses, forbs, and sedges, and leave evidence of each treatment (i.e. fire scar and small tree mortality). The savanna areas of National Forest System lands in MAs 4.4 and 6.1 would produce a moderate degree of the desired scenic condition, with common expressions of the desired landscape elements occurring in some harmony across the Project Area. The forested areas of National Forest System lands in MAs 4.4 and 6.1 would show evidence of other timber harvesting (i.e. plantation thinning and regenerating aspen and oaks). The scenic objective in MA 9.2 would not be directly affected, but there would be a greater contrast in the characteristic landscape elements among MAs with Alternatives 2 and 3. Fewer Forest roads open to motorized uses would further promote a more naturally appearing landscape.

The effects related to private land management within the Project Area would be consistent with those discussed under Alternative 1.

Conclusion: The duration and magnitude of the proposed actions would incrementally add to past, present, and reasonably foreseeable scenic integrity objectives within the Project Area, primarily by converting mature oak and aspen forests to savanna/barrens, and allowing other hardwood and conifer forests to mature or be replaced by late-seral stages of forest vegetation. This effect will be most pronounced on National Forest System lands. Private lands are expected to shift towards building site development and recreational uses, woodlands, and upland open uses (i.e. unimproved pasture and game species habitat improvement).

(3.14) Transportation

(3.14a) Existing Condition and Resource-Specific Information

Historical Context

Roads are intrinsically linked to the presence and use of an area by humans. The location and abundance of roads on a landscape can serve as good indicators for how that particular landscape has been used over time. The transportation system throughout the Project Area is reflective of the historical land use. Because of the proximity of this area to the North, South, and Main Branches of the White River, there was a rich history of land use in this area by Native Americans. There is evidence of this use along and within the river corridor throughout the Project Area. It is likely that there was a system of well-established footpaths associated with the encampments located along the river throughout the Project Area to facilitate this use.

Prior to the establishment of homesteads by settlers, the areas that were capable of supporting timber were logged. With this, came the establishment of a rudimentary road network that allowed the loggers to transport harvested trees to the edge of the river, where they were rolled over the banks to be floated down the river to the mills. Evidence of these rollways still exists in the Project Area. In addition to logging activities, there is also evidence of past agricultural use throughout the Project Area. As a result, the road system within the Project Area became well-established and received increased use from draft animals and, later, motor vehicles as people traveled more frequently outside of the Project Area for the exchange of goods and services. The low soil productivity (in conjunction with external economic factors) led to the eventual abandonment of these farms. The lands (and some of the associated roads) eventually reverted to public ownership and became a part of the Manistee National Forest.

As part of the National Forest System lands, the roads that already existed continued to be utilized for forest management activities (planting, harvesting, etc.). New roads were also developed for these purposes. Most of the Forest roads typically served as a part of former timber hauling road networks, leading from log landing locations to county roads. Because of the infrequent use and maintenance of these roads, many are currently not up to standard and are not suited for use by low-clearance passenger vehicles. There are also several of these roads that are utilized by private property owners to access their property. Until recently, the use of these roads for timber management purposes was periodic (occurring every 10-15 years), with the majority of annual Forest Service use taking place in the form of recreation patrols.

Over the past few decades, motorized vehicles have become increasingly popular with those who use the Forest for recreation. This has led to a reliance on these vehicles to access the Project Area for motorized-dependent camping, horseback riding, hunting and fishing access, snowmobiling, driving for pleasure, wildlife viewing, firewood and mushroom gathering, and more. These activities incorporate the use of all of the accessible roads. In some locations, roads that were originally developed to service forest management activities are now used exclusively for recreational purposes.

Classification

In discussing the management of the transportation system within the Project Area, the IDT has categorized the roads as: 1) county roads, 2) classified roads, or 3) unclassified roads. For this project, county roads are those roads that are claimed, maintained, and under the jurisdiction of either Oceana or Muskegon County. The management of these roads is carried out by the respective Road Commissions. Some of these roads are maintained throughout the year, and some are maintained seasonally (not being plowed during the winter months).

Classified roads are under the jurisdiction of the Forest Service, are wholly or partially within or adjacent to National Forest System lands, have been previously designated as needed for motor vehicle access, and are included on the Huron-Manistee National Forest Motor Vehicle Use Map (MVUM). Typically, these roads have been created by the Forest Service, are seasonally open, and receive minimal to no maintenance. Classified Forest Service roads are utilized during the spring, summer, and fall by recreationists and local traffic. These roads are not plowed in the winter.

Unclassified roads are also under the jurisdiction of the Forest Service and are on National Forest System lands. These include unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail. These may also include roads that were once under a permit or other authorization and were not decommissioned upon the termination of the authorization. These roads have been created through a variety of means. Some were originally developed by the Forest Service to conduct management activities, but were not incorporated into the official road system. Some are roads developed prior to Forest Service ownership by previous landowners. Some have been illegally created by Forest users. Many of these roads are either duplicates (lead to the same location as another road) or dead-end.

Road Density

In Michigan, and within the Project Area, the presence of roads on the landscape has, in some ways, remained more consistent than the landscape itself. As already discussed, some areas have gone from forest to farm and back to forest, while having the same series of roads to provide access to the area. While roads have historically served as important known access routes for both public and administrative use, their potential impacts upon erosion and the delivery of sediment into water systems (i.e. the White River) can exceed that of all other management activities considered in a watershed (Brooks et al., 2003). While frequent and appropriate maintenance of the roads can reduce this impact, this level of maintenance on Forest roads is not common.

Roads also serve to provide the public with their primary means of accessing the Forest for recreation. Currently, most forms of recreational use on the Forest involve some form of motorized vehicle access. Even those who enjoy non-motorized recreational activities (i.e. hunting, fishing, and hiking) use the roads and motorized vehicles to get close to the areas that they enjoy recreating in. As evidenced by the responses to the scoping for this project, there are some people who would be unable to enjoy the use of an area if motorized access was limited or restricted. Likewise, the scoping responses indicated that there are some people who would

prefer the more solitary recreational experience that would be promoted by a decrease in motorized access.

The common unit of measure for the level of roads that are present on a specified land area is referred to as the road density. This is typically expressed as the miles of road per unit of land (i.e. square mile). This measure allows comparisons to be made between the amount of roads that are present in different watersheds and of different areas within the same watershed. As most areas within the boundaries of the Forest are fragmented with private land ownership, there is difficulty is accurately calculating this value and clearly understanding the impacts that this value may represent. For, while there may be relatively accurate measures for the roads that are claimed and maintained by the respective counties and the Forest Service, there are not such records for private lands. Short of gaining access to all of the private lands within a Project Area, the best means currently available for estimating the density of the roads on these lands is using aerial photographs. Therefore, a truly accurate portrayal of the road density that exists on private land is not included in this analysis, but efforts have been made to ascertain an estimate based on this technique.

County roads within the Project Area have been identified by using the Act 51 maps that are produced by the respective counties. These maps reflect the county roads that a particular county claims as part of its official road system. To avoid the double counting of these roads (in future projects adjacent to this Project Area), the IDT has used ½ of the total value of county-claimed roads for the areas where the county roads serve as a Project Area boundary. The total value of county-claimed roads has been used for areas that are completely within the Project Area.

The classified roads that are under the jurisdiction of the Forest Service within the Project Area have been identified through the use of the MVUM. To avoid the double counting of these roads in future road density calculations, the IDT has used ½ of the total value of classified roads for the areas where they serve as Project Area boundaries. Unclassified roads within the Project Area have been identified through the historic roads layer of the Forest Service's Geographical Information System (GIS). Roads that have been previously closed are not included in this value and, as a result of user-created roads, it is likely that more unclassified roads exist within the Project Area than what is included on the GIS layer that has been used for this analysis. Therefore, the values for unclassified roads are likely to be artificially low.

For this analysis, the road densities have been calculated two ways. First, only those county and Forest Service roads on the MVUM or adjacent to the Project Area boundary were counted; boundary roads were counted at ½ value to avoid double-counting. This calculation only considers roads on National Forest System lands and this data is displayed in the first column of Table 3.40. Because the effects relative to the presence of roads is not constrained by jurisdiction or ownership, a second calculation of road density of all roads all ownerships within the Project Area, including unclassified or previously closed roads on National Forest System lands, was completed. This information is shown in column 2 of Table 3.40.

The entire Project Area consists of approximately 26,000 acres or 40.6 square miles. Of this, approximately 15,000 acres (23.4 square miles) are National Forest System lands and 11,000 acres (17.2 square miles) are in private holdings.

Table 3.40: Project Area Road Data

Type	All Roads on National Forest System Lands within the Project Area (Includes County roads adjacent to National Forest System lands and Forest Service roads shown on the MVUM)[1]			All Roads on All Ownerships within the Project Area (Includes County, Forest Service, Private, and Unclassified/User Created Roads)[2]		
All Management Areas Within the Project Area						
Road Mileage	45.8			137.3		
Area of Consideration acres/sq miles	15,037			26,048		
	23.4			40.6		
Current Road Density (miles/mi^2)	2.0			3.4		
Acres Impacted by Existing Roadbed (assumes average road width of 12')	67			200		
% of Area Impacted by Existing Roadbed	0.4			0.8		
Management Area 6.1- Semiprimitive Nonmotorized Existing Condition						
Road Mileage	22.0			49.6		
Area (acres)	7,590			8,180		
Current Road Density (miles/square mile)	1.8			3.9		
Acres Impacted by Existing Roadbed (assumes average road width of 12')	24			72		
% of Area Impacted by Existing Roadbed	0.3			0.9		
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 1**	**Alternative 2**	**Alternative 3**
Total Miles of Road Left Open	22.0	12.0	12.0	29.1	19.1	19.1
FS MVUM Roads	11.0	1.0	1.0	11.0	1.0	1.0
County and Estimated Private Roads	11.0[3]	11.0[3]	11.0[3]	18.1	18.1	18.1
Unclassified FS Roads	0	0	0	0	0	0
Square Miles of Land	11.9			12.8		
Final Road Density	1.8	1.0	1.0	2.3	1.5	1.5

Table 3.40 (continued): Project Area Road Data

Management Area 4.4 - Rural Existing Condition						
Type	**All Roads on National Forest System Lands within the Project Area** (Includes County roads adjacent to National Forest System lands and Forest Service roads shown on the MVUM)[1]			**All Roads on All Ownerships within the Project Area** (Includes County, Forest Service, Private, and Unclassified/User Created Roads)[2]		
Road Mileage	**24.0**			**87.8**		
Area (acres)	**7,447**			**17,868**		
Current Road Density (miles/square mile)	**2.0**			**3.1**		
Acres Impacted by Existing Roadbed (assumes average road width of 12')	**35**			**128**		
% of Area Impacted by Existing Roadbed	**0.5**			**0.7**		
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 1**	**Alternative 2**	**Alternative 3**
Total Miles of Road Left Open	**24.0**	**24.3**	**23.6**	**78.6**	**78.9**	**78.2**
FS MVUM Roads	**9.4**	**8.9**	**8.2**	**9.4**	**8.9**	**8.2**
County and Estimated Private Roads	**14.6[3]**	**14.6[3]**	**14.6[3]**	**69.2**	**69.2**	**69.2**
Unclassified FS Roads	**0**	**0.8**	**0.8**	**0**	**0.8**	**0.8**
Square Miles of Land	**11.6**			**27.9**		
Final Road Density	**2.1**	**2.1**	**2.0**	**2.8**	**2.8**	**2.8**

[1]Roads which serve as Project Area boundaries are multiplied by 0.5 to avoid duplicative counting.

[2]County roads which are adjacent on only one side of the road or which serve as Project Area boundaries are multiplied by 0.5 to avoid duplicative counting.

[3]Does not include the estimated roads on private land and includes only those county roads which are adjacent to NFS lands.

Relating Transportation System Management to the Forest Plan

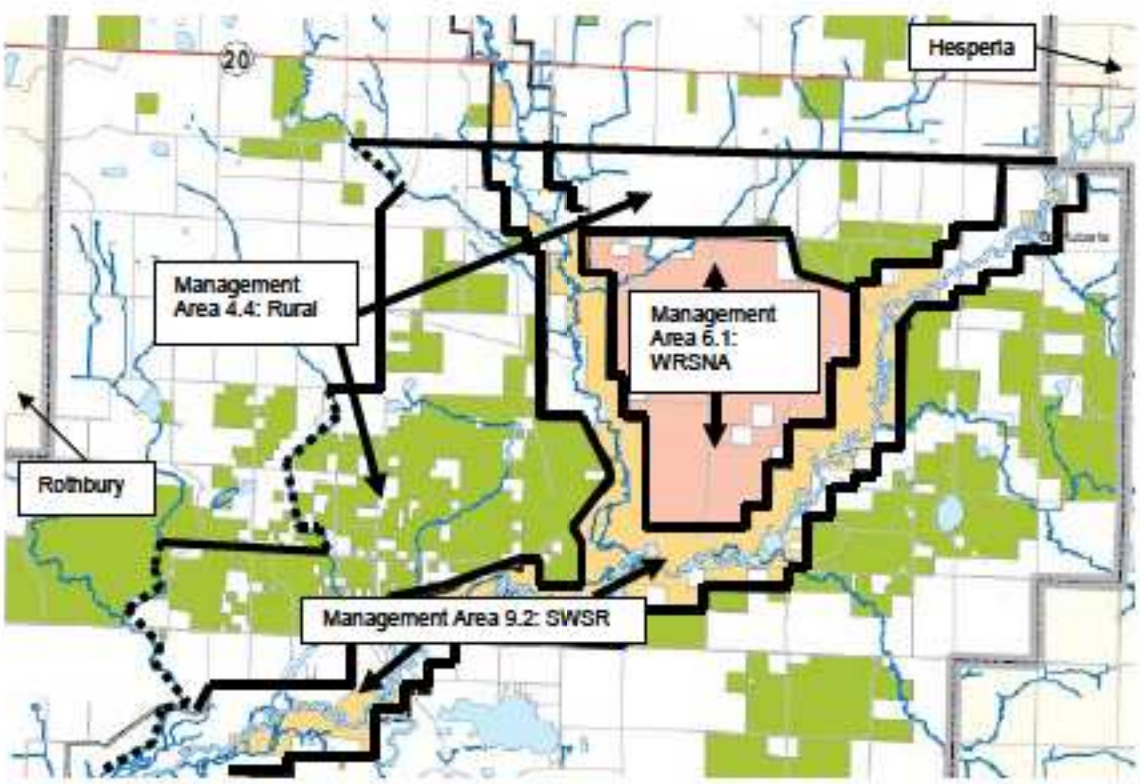
The Forest is divided into different Management Areas (MA), with each area having Standards and Guidelines that apply to the management of the transportation system (Forest Plan 2006). The MAs for this project are 4.4 (Rural), 6.1 (Semiprimitive Nonmotorized), and 9.1 (Study Wild and Scenic River) (see Map 3.14). The following table shows the desired road densities for these MAs.

Table 3.41: Desired Forest Plan Road Densities by Management Area

Average Miles of All Roads per Square Mile:	Applicable Management Area:
0-1	6.1
0-3 Miles	4.4

(No average miles listed for Management Area 9.2)

Map 3.14: Management Areas within the Project Area



Management Area 6.1: Semiprimitive Nonmotorized Area

The National Forest System lands within the Project Area that are included in this Management Area (MA) occur south of Arthur Road, east of the North Branch of the White River, and west of the South Branch of the White River. This area consists of fairly contiguous Federal ownership, with some private parcels interspersed. The White River was designated as a Semiprimitive Nonmotorized Area (WRSNA) in 1986 under the Huron-Manistee National Forests' Land and Resource Management Plan (Forest Plan). This designation was not modified by the 2006 Forest Plan update. At the time of the initial designation, the area was used primarily for motorized-dependent recreation (i.e. camping) and to provide access for non-motorized forms of recreation (i.e. hunting and fishing). Much of this recreation was directly related to the large block of contiguous public land and the presence of the North and South Branches of the White River, with many dispersed camping and day use-sites located along the banks. Since the time of designation, many of the roads that had previously provided access to these areas have been closed through a combination of barrier posts and gates. Barrier posts were used on the roads that were considered not needed for administrative use. Gates were used in locations that were either identified as needed for administrative use or that were to be opened seasonally to allow hunter access, per the Settlement Agreement for the 1986 Forest Plan.

Due to historic and continued high levels of motorized-dependent recreation occurring throughout the White River Area, many of the road closures have been breached by those accessing these areas with vehicles. Gates were pulled out, rammed into, or driven over and

barrier posts and signs were pulled out or cut down. Maintaining these road closures has meant continual monitoring and the re-enforcement of closures at breached locations. Where closures have held, the old roadbeds are beginning to naturalize. At most of the dispersed river access points, restoration projects following road closures have been successful in restoring a more natural setting. There is still evidence of the motorized use that occurred previously at these locations, but this is gradually becoming less.

The road system that has remained open includes a combination of county roads (Oceana) and classified Forest Service system roads. The county roads in this area include Arthur and Winston Roads, and 168th, 160th, 152nd, and 148th Avenues. The Forest Service roads that are currently open (seasonally or year round) include: FR5306, FR5637, FR9045, FR5295, FR7992, FR5315, and FR9353. This network of roads provides public and administrative access throughout the area. This access is limited to the spring, summer, and fall seasons, as none of the roads are maintained during the winter months. Use of the road system by the public is primarily for recreational access, as the area remains very popular for camping, horseback riding, hunting, fishing, and driving for pleasure. Due to previous closures, those utilizing this area for motorized-dependent recreation have been channeled onto the road system that has remained open. Features associated with this road network include dispersed campsites, historic footpaths to the river, and non-designated parking areas. In addition, the existing road system provides access to the private property within the area.

The administrative use of the roads in this area has changed over time. Previously, these roads were used primarily by staff for conducting recreational patrols (law enforcement), timber management, and to aid in the suppression of the occasional wildfire. With the identification of occupied Karner blue butterfly (KBB) habitat in the White River, the administrative use of these roads has increased in order to conduct butterfly and vegetative surveys, identify locations of suitable habitat, and (most recently) to conduct management activities that support the restoration and maintenance of the habitat for this endangered species.

Within the WRSNA, there are occupied KBB sites with roads through them and sites adjacent to roads. While some roads are necessary for administrative access for the management of this species, there are locations where the roads (and their associated features) have been blocked to prevent impacts to habitat and individuals from motor vehicle traffic.

The majority of roads in this area range in width from 8-16' and are passable with a low-clearance passenger vehicle. The roadbeds are well-established, consisting mainly of sand. The sand is compacted on the level straight-aways, but loose at the bottom of slopes and on the tighter corners. There are a number of locations where the combination of high sand content and slope can make passage with passenger motor vehicles difficult. These factors also currently limit the size of camping/horse rigs that are capable of accessing some areas in the southern and western portions. As a result, there is a disproportionate amount of this use occurring in the northern and eastern portions of the WRSNA. There is adequate vegetative clearing along all of the open roads to allow for vehicle passage.

Management Area 4.4: Rural

The Otto portion of the Project Area is in this Management Area and is west and north of the WRSNA. The southern portion is bordered by water, with the Main Branch of the White River forming the southern boundary, the North Branch of the White River forming the eastern boundary, and Sand Creek forming the western boundary. In the north, the Management Area expands to the east with 128th Avenue forming the western boundary, Garfield Road forming the northern boundary, Arthur Road forming the southern boundary, and the South Branch of the White River forming the eastern boundary. While the character of this part of the Project Area differs from that of the WRSNA, recreational use and access to private in-holdings have shaped the development and use of the road system in this area.

The presence and use of the roads in this area is the heaviest leading up to, and adjacent to, the Main and North Branches of the White River, respectively. Both county (Oceana and Muskegon) and Forest Service roads serve as a means of access for camping and recreational day use. The amount of use that occurs varies considerably by season, with campers being most frequent throughout the summer months and the use of the roads by hunters and anglers increasing late summer and fall.

Comparative to the efforts to manage the transportation system in the WRSNA, there has been reduced levels of maintenance and control of the development of user-created roads in this portion of the Project Area in the recent past. With the development of the Motor Vehicle Use Map (MVUM), some of the unclassified roads that were being used to access the Main Branch of the White River are not part of the official transportation system. Of these roads, few were designed to any standards and as they deteriorated many new user-created spur roads were created. Road closures in the WRSNA displaced some users to the Otto portion of the Project Area. This is particularly evident in the areas providing public access to either the North or Main Branches of the White River. These factors have contributed to recent increases in the creation of both unclassified roads and dispersed camping areas. These are most evident off of Sand Road/FR9310 along the Main Branch of the White River in the south and off of FR5107 along the North Branch of the White River in the north.

Roads not on MVUM are not recognized as part of the official Forest transportation system and are subject to closure at any time. Roads that are identified to be included on the updated MVUM must go through the project level NEPA process unless they were existing Forest roads that were mistakenly not identified as such during the creation of the MVUM. These roads may be added to the map as part of the annual MVUM review. In reviewing this Project Area for updates to the MVUM, the Interdisciplinary Team identified two changes that would be incorporated under Alternatives 2 and 3.

1. FR9301 (0.4 miles): This is a north/south road that runs north of Skeels Road and lies west of Sand Creek. All of the property bordering Sand Creek in this area is in private holdings where the road dead-ends and on-going management activities are in conflict with the existing location of the road. Under Alternatives 2 and 3, this road would be eliminated from MVUM, gated, and put under a Special-Use Permit.
2. FR9320 (0.8 miles): This is an east/west road that runs east off of 128th Avenue, before connecting with Kent Road on private property to the east. A field review determined

that it had been previously improved with gravel and a culvert. It provides access to private property and is utilized as a connector to 142nd Avenue. Under Alternatives 2 and 3 the portion of this road on National Forest System lands would be added to the MVUM (*see Otto Metapopulation Area: Alternatives 2 and 3 Recreation Management maps at the end of Chapter 2*).

In addition to these, there is one location within this Management Area where there would be a conflict between an open Forest road (the eastern portion of FR9310) and the objectives of implementing the KBB Recovery Plan. Under Alternative 3 this portion of this road would be closed to motor vehicles and the traffic from this road would be re-routed onto segments of FR9870 and FR9311. This closure would be included as a change to the MVUM. Under Alternative 2, the eastern portion of FR9310 would remain open to motor vehicles and efforts would be made to protect the habitat with barrier posts. Under all of the alternatives, this portion of the FR9310 would remain open as part of the West Shore Snowmobile Trail, December 1 – March 15.

The fragmented land ownership is common in Management Areas 4.4 - Rural. Within the Project Area, 93% of the ownership in the WRSNA is National Forest System lands. This compares with only 42% within the Otto portion of the Project Area. With this fragmentation in ownership, there is typically an increase in the amount of local traffic that utilizes the Forest Road system for accessing their property and travels to and from the area. Typically, these areas also see increased motorized/dispersed recreation, firewood gathering, and illegal activities (i.e. ORVs and trash dumping) over those MAs with fewer roads. Based on location and ownership patterns, Rural Management Areas are typically heavily utilized by the public for a wide variety of reasons. This use is true for the existing transportation system and its associated features in this area.

Management Area 9.2: Study Wild and Scenic River

This designation includes those areas that are within ¼ mile (1,320') on either side of the North, South, and Main Branches of the White River. For this Project Area and analysis, the portions of this Management Area that are considered include both sides of the North Branch and the northern side of the South and Main Branches of the White River. The objective within this area is to maintain the integrity of this corridor for the characteristics that the river is being considered for designation under the Wild and Scenic Rivers Act. In the case of the White River, these characteristics are the recreational and cultural attributes (FEIS, 2006).

The road system within the Project Area currently supports a variety of recreational uses within this Management Area. There are areas in the southern and eastern portions of the WRSNA where the roads provide motorized access within ¼ mile of the South Branch of the White River. In the western areas of the WRSNA, while the roads do not allow for motorized public access to the corridor, they do allow users to get closer to the corridor for non-motorized recreational use (i.e. hunting and fishing).

In the Otto portion of the Project Area, the existing road system provides motorized access up to and within the Study Wild and Scenic River corridor. The majority of this access occurs just west of where the North and South Branches come together to form the Main Branch of the

White River. Here the road system has been historically utilized for motorized-dependent dispersed camping. At some locations (i.e. FR9309), existing roads lead right to the banks of the river. There are also areas where unclassified roads (not on MVUM) exist and have historically provided motorized access within the corridor. Of these, few were developed to any standard or been maintained. There are five such sites within the corridor that will be restored through a State of Michigan ORV grant. North of this area (along the North Branch of the White River), there are fewer roads and, thus, fewer access point to provide motorized access. However, two classified Forest Roads (FR9859 and FR5107) do serve as popular sites for both dispersed camping and fishing access. The southwestern portion of the Study Wild and Scenic River corridor consists almost exclusively of private lands. The Forest Service has no jurisdiction over the roads in these areas.

There is a distinction between areas that are designated as old growth and areas that are within the Study Wild and Scenic River corridor. While there are portions within this corridor that carry the old growth designation, the entire corridor is not designated as such (FEIS, III-45). The entire corridor (including both sides of the North, South and Main Branches) is comprised of approximately 14,300 acres. Of this, only 4,200 (29%) are National Forest System lands (HMNF GIS Layer, 2010). The remaining 10,100 acres are under other ownership.

(3.14b) Area of Analysis

The activities affecting the transportation system that are proposed with this project pertain only to those roads that are under the jurisdiction of the Forest Service on National Forest System lands. Therefore, it is these lands within the Project Area that make up the area of analysis for the direct and indirect effects. As the transportation system throughout this area consists of a matrix of Forest, county, and private roads, all three jurisdictions within the Project Area make up the area of analysis for the cumulative effects.

(3.14c) Direct and Indirect Effects

Alternative 1

Management Area 6.1: Semiprimitive Nonmotorized Area

Under this alternative, the county roads and the existing classified Forest Roads (as shown on the MVUM) would remain open within the WRSNA. Any unclassified roads (not shown on the MVUM) would be subject to closure at any time. Leaving the existing classified Forest Service roads open would not be in compliance with Forest Plan (2006) direction for the White River Semiprimitive Nonmotorized area.

The existing road system would continue to provide access for motor vehicles within the WRSNA. Monitoring, maintenance, and re-enforcement of the existing closures would continue. The roadbeds of the existing closures and the locations where restoration efforts took place along the river would continue to be restored through natural processes. Evidence of motorized use would remain on the open Forest roads, county roads, and the gated roads that are open seasonally or for administrative purposes.

Motorized access throughout this area would continue to be limited to the spring, summer, and fall seasons. Use of the road system by the public would likely continue to be primarily for recreational access related to the North and South Branches of the White River. This use would increase if the area becomes more popular for camping, horseback riding, hunting, fishing, and driving for pleasure. This would also apply to other associated features of the transportation system, which includes: dispersed campsites, historic footpaths to the river, and non-designated parking areas. In addition, the existing roads would continue to provide access to the private property within the area.

Portions of this Management Area would be managed as part of the White River Metapopulation Area for the Karner blue butterfly. As a result, the administrative use of the open Forest Service roads (and some that are gated) would continue to conduct butterfly and vegetative surveys, identify locations of suitable habitat, and (relative to the on-going projects) to conduct management activities that support the restoration of habitat for this species.

Existing roads would go through, or would be adjacent to, sites that are currently occupied by the Karner blue butterfly. The continued use of some roads that are currently gated would be necessary to provide administrative access for the management of this species. In addition to the locations where the roads (and their associated features) have already been blocked to prevent impacts to KBB habitat, protection measures would likely be necessary where open roads intersect with existing occupied sites.

The width of the roads would not likely change from what currently exists. If habitat protection measures along roads were found to be necessary, then the width of the roads would be defined more clearly and the expansion of the road would be limited. Most roads would continue to be passable with a low-clearance passenger vehicle, though this would be compromised at the locations where loose sand continued to accumulate at the bottom of slopes and on the tighter corners. In these areas, there would likely be limitations on low-clearance vehicles and specialized recreational vehicles (i.e. horse rigs, campers, etc.). As a result, the roads that would allow for the passage of these vehicles would determine where these recreational activities would occur at a higher frequency. The current trends in use would indicate that this would be in the northern and eastern portions of the WRSNA. As a result of continued administrative and public use, the roadbeds would continue to be well-established and there would be adequate vegetative clearing along all of the open roads for vehicle passage.

In comparison: This alternative would provide the maximum amount of motorized public access throughout the WRSNA. The resulting road density within the WRSNA (1.8 miles/square mile) would be greater than Alternatives 2 and 3 and above the Forest Plan desired road density for Management Area 6.1 (0-1 miles/square mile) and would not comply with the Forest Plan Guideline to: "Close all Forest Service roads to motorized vehicles except for emergency and administrative use."

Management Area 4.4: Rural

Recreational use and access to private in-holdings would continue to shape the development and use of the road system in this area. The densities and use of existing roads on National Forest System lands would remain the highest in the areas that lead up to, and are adjacent to, the Main and North Branches of the White River. Both county and Forest Service roads would

serve as a means of access for camping and recreational day use. There would be no anticipated change in the maintenance level of these roads, so the amount and type of use would continue to vary by season, with campers being most frequent throughout the summer months, the use of the roads by hunters and fisherman increasing into late summer and fall, and the use of the roads during the winter months being limited by the amount of snow.

The MVUM identifies which Forest Service roads are part of the official transportation system. The roads that have historically been considered as unclassified roads are no longer considered as open roads. Without the use of the MVUM, the average user in this area may have difficulty in identifying which roads are included as part of the official system. The historic unclassified travel routes that are not shown on MVUM would be subject to closure at any time. Though unclassified roads could be closed, all National Forest System lands would remain open to the public. Varying levels of motorized use occurs on these roads; the physical closure of them will increase the amount of motorized use on open Forest Service and county roads. For those roads that are on the MVUM:

1. This increase would have effects on the physical characteristics of the roads (i.e. soil compaction/displacement, widening, rutting), as well as the social elements relating to the use of the roads (i.e. higher number of motorized-dependent users utilizing fewer roads and features).

2. There would be an increase in the number of features associated with the road system. As the existing roads receive little to no maintenance, the quality of the roads would deteriorate over time. This would lead to an increase in the number of areas where passage by motorized vehicles is difficult and in the number of user-created "go-arounds", pull-offs, undesignated parking areas, and dispersed campsites.

For those travel routes which are not part of the official transportation system:

1. The use of these areas by motor vehicles would be eliminated. The existing roadbeds would gradually be restored, either through planned restoration projects or natural processes. The presence of the existing roadbeds and the associated features would be present on the landscape for many years to come.

Landownership throughout the Otto portion of the Project Area would continue to be fragmented. This means, the existing road system would continue to be utilized by local traffic for private property access and travel to and from the area. By providing the maximum amount of access, this alternative would result in the highest levels of motorized/dispersed recreation, firewood gathering, and have the greatest potential for illegal activities (i.e. ORVs and trash dumping). The use of this area would continue to be evident on the existing transportation system and its associated features.

In comparison: The resulting road density under this alternative would be the same as Alternative 2 (2.1 miles of roads/square mile). This density would be only slightly more (0.1 miles) than Alternative 3. All of the alternatives would be within the Forest Plan desired road density for Management Area 4.4 (0-3 miles/square mile).

Management Area 9.2: Study Wild and Scenic River

Under this alternative, the county roads and existing Forest Service roads that are on the MVUM would remain open and continue to provide access to the Study Wild and Scenic River corridor. As the river is being considered for a Recreational designation, the continued presence of these roads in the corridor would not detract from the values for which the river is being considered. There are no Standards or Guidelines related to transportation for Study Wild and Scenic Rivers.

The road system would continue to support a variety of recreational uses within this Management Area. Roads in the southern and eastern portions of the WRSNA would provide motorized access within ¼ mile of the South Branch of the White River. In the western portion of the WRSNA, the lack of open roads prevent motorized public access directly to the river, however, users can get access by walking from road ends for non-motorized recreational use (i.e. hunting and fishing).

In the Otto portion of the Project Area, the road system would continue to provide motorized access up to and within the Study Wild and Scenic River corridor. The majority of this access would occur just west of where the North and South Branches come together to form the Main Branch of the White River. In this area, some of the unclassified roads (not on MVUM) would be subject to closure at any time. The closure of these roads would limit motorized access to portions of the corridor that have historically been used for motorized-dependent recreation (both day use and dispersed camping). Under this alternative (through the implementation of the MVUM), the motorized access to the river would be limited, with most of the access points being limited to the bluff above the corridor and an unimproved site that allows users direct access to the banks of the river (FR9309). The high recreational use that occurs at this site, coupled with the steep slope and the sandy soils, are contributing to the mass transport of soil into the Main Branch of the White River at this location. This would continue to occur under this alternative and would likely worsen over time due to the anticipated increase in use that would be associated with the channeling of motorized-dependent recreation to fewer areas.

The ORV restoration work at the five sites would occur separate from the Decision for this project. This work would reduce the number of damaged sites that are within the corridor and limit the potential for illegal motorized access into the Study Wild and Scenic River corridor via the unclassified road network. North of this area (along the North Branch of the White River), there would continue to be fewer roads and, thus, fewer access point to provide motorized access. The two classified Forest Roads (FR9859 and FR5107) would continue to serve as access points to the North Branch of the White River. Dispersed camping would likely continue in this area, with the greatest use being associated with fishing and hunting seasons, respectively. The southwestern portion of the Study Wild and Scenic River corridor would continue to consist almost exclusively of private lands. The Forest Service would have no jurisdiction over the roads in these areas.

Under all of the alternatives, there would continue to be a distinction between areas that are designated as old growth and the areas that are within the Study Wild and Scenic River corridor. While there would be portions within this corridor that would carry the old growth designation, the entire corridor would not be designated as such (FEIS, III-45).

In comparison: This alternative would provide more motorized access within the Study Wild and Scenic River corridor than Alternatives 2 and 3, as all of the existing classified Forest Roads would remain open. In considering the transportation system as a whole, none of the alternatives would jeopardize the recreational or cultural attributes for which the river is being considered for designation.

Alternatives 2 and 3
Management Area 6.1: Semiprimitive Nonmotorized Area

Under these alternatives, the remaining classified Forest Service roads within the WRSNA would be closed. These are identified in the following table.

Table 3.41: Alternatives 2 and 3 Road System Proposals in the White River Portion of the Project Area

Road Number	Existing Condition	Description	Alternatives 2 and 3 Desired Condition
FR5306	Open Seasonally	This road is in the southwestern portion. It is currently gated and open for 2 weeks during firearm deer hunting season.	This road would be closed to motorized vehicles and stored for administrative use.
FR5637 (A,B,C)	Open	This paved road serves as the northern boundary and the main road to access the Pines Point Campground.	This road would remain open to motorized vehicles.
FR9045	Open	This is an east/west road that connects 160th Avenue with FR5306 at the intersection of Winston Road.	This road would be closed to motorized vehicles and stored for administrative use.
FR5295	Open	This road is the main north/south Forest Service road that runs along the South Branch of the White River. This road is currently gated in the south, but a spur (FR9533) leads to an area that has historically been used for dispersed recreation.	This road would be closed to motorized vehicles and stored for administrative use.
FR7992	Open	This road is in the northwestern portion and currently serves as a connector between 148th and 152nd Avenues.	This road would be closed to motorized vehicles and stored for administrative use.
FR5315	Open Seasonally	This north/south road is shown as open seasonally on the MVUM; however, there are currently no gates. The road leads into and out of private property, which makes it appear as a segmented road on the MVUM.	This road would be closed to motorized vehicles. The private landowner would retain access through a special-use permit and the road would be stored for administrative use.
FR9353	Open	This road is located in the southeastern portion. It serves as a southern spur off of FR5295 and leads to several dispersed campsites associated with the South Branch of the White River.	This road would be closed to motorized vehicles and stored for administrative use.

Under these alternatives, only the county roads would remain open within the WRSNA. These would include: 148th, 152nd, 160th, and 168th Avenues, and Winston and Arthur Roads (adjacent). These actions would be in accordance with the Forest Plan (2006) management direction for the White River Semiprimitive Nonmotorized Area.

The type of closure of Forest Service roads would be dependent on whether or not there is a need to access areas for administrative purposes (i.e. KBB habitat creation, restoration, and maintenance) or for private land access. Forest Service road closures (old and new) would require monitoring, maintenance, and re-enforcement, especially in locations that are accessible from the open county road system. While the roadbeds of some of these closures would continue to be restored through natural processes, efforts would be made in other areas to restore the roadbed. Whether or not active restoration of the roadbeds occurs would depend on the anticipated future need to utilize the road to conduct management activities. There would be continued evidence of motorized use within the WRSNA on the county roads and on the decommissioned Forest Service roads used administratively to conduct butterfly and vegetative surveys, identify locations of suitable habitat, and to conduct management activities that support the restoration of KBB habitat.

Depending on the level of periodic maintenance, most of the county roads would continue to be passable with a low-clearance passenger vehicle. This would be compromised at locations where loose sand accumulates at the bottom of slopes and on the tighter corners. The roadbeds of the county roads would continue to be well-established and there would be adequate vegetative clearing along all of the open roads to allow for vehicle passage.

Under Alternatives 2 and 3, there would be increased amounts of traffic related to timber harvesting on both the county and the existing Forest Service roads. Road improvements and minor amounts of road development would be necessary in some locations to accommodate this use. These improvements could include leveling, hardening, road clearing, the development of specified entrances, and drainage improvements. There would be temporary disturbances to the primary haul roads, in which rutting, compaction, and soil displacement would occur. These areas would be identified and rehabilitated post-sale. In some instances, user-conflicts would occur in areas where timber harvesting activities take place. This would occur most often in the areas used for recreation by the public. There is no difference in the acres of vegetative treatments between Alternatives 2 and 3 so there would be no discernible difference in the amount of road traffic.

There are two distinct desired outcomes for the forested stands prescribed for treatment: 1) those areas that are currently forested and would likely be managed for timber purposes again in the future (i.e. red pine thinning), and 2) those areas that are currently forested, but would not likely be managed for timber purposes in the future (i.e. savanna creation). While the areas proposed for red pine thinning would remain as part of the commercial timber base for the Forest, the areas proposed for savanna creation would not. The desired future condition of these treatment areas would be very different, but commercial timber harvesting would serve as the initial action under both. As a result, under this project, the effects on the transportation system relating to the removal of timber would be similar.

Many of the treatment areas would be located adjacent to existing county roads. These would serve as the primary haul roads. The level of use on any particular road would vary based on the characteristics of the existing road. Roads needing minimal improvements and capable of withstanding the type of traffic that is commonly associated with harvesting activities (i.e. transporting equipment, loaded timber trucks, etc.) would be preferred. During the period of

hauling, there would be an increase in the amount of traffic on these roads and the quality of the roads would be reduced.

In addition to the initial timber harvesting activities, use of the existing road system for management activities associated with the creation and maintenance of savanna would occur. These include such activities as: additional vegetative treatments (i.e. mechanical and/or chemical), site preparation, prescribed burning, seeding and planting, and conducting surveys. The roads used to conduct these activities would include a combination of the existing county roads and Forest Service roads.

There would be no open Forest Service roads going through or adjacent to sites that are currently considered occupied by the KBB. However, there would continue to be county roads that go through or are adjacent to these sites. In addition to the locations where the roads (and their associated features) have already been blocked to prevent impacts on the KBB, protection measures would likely be necessary along the county roads where they intersect with existing occupied sites. At these locations, the width of the roads would be defined more clearly and the expansion of the road would be limited.

The type of closure to be used on Forest Service roads would be identified at the time of implementation. Those roads identified as necessary for administrative use would be gated to allow access to conduct and monitor management activities associated with the implementation of the KBB Recovery Plan. There would be visible use of these roads and the roadbeds would remain intact; however, the increased inputs of organic material and the reduced use would allow portions to become narrower and partially re-vegetated. Vegetative clearing adjacent to the gated roads would be necessary to accommodate the passage of the vehicles and equipment necessary to conduct management activities.

The Forest Service roads not needed for administrative access would be permanently closed using a variety of methods (i.e. berms, stumps, rocks, barriers posts, etc.). The type of closure and the restoration methods used would vary and be dependent on the proximity of the road to the savanna creation activities or the anticipated need of the road for future management activities. Restored roadbeds would blend with the surrounding vegetation. Those roads adjacent to or within savanna units would be obliterated. The roadbeds not associated with the savanna creation units would be restored naturally through succession. Many of these roadbeds would be visible on the landscape for many years. The length of time would be dependent on the history of use, the surrounding vegetative type, and the localized soil conditions.

Under these alternatives, parts of the county and existing Forest Service roads would also serve as control lines for prescribed burning and would provide access to the burn units. The type and size of a control line that would be required for a particular prescribed burn would vary based on the surrounding vegetation type and the size, objectives, and timing of the burn. The control lines would be prepared prior to each burn. For the existing county roads, little preparation would be necessary, because they are exposed mineral soil and 8-16′ in width. The use of county roads as control lines for prescribed burning activities would not impact be the anticipated future use of these roads.

The effects of using the existing Forest Service roads for control lines would depend on the type of closure. Gated roads would continue to receive periodic use from Forest staff. This use would promote the presence of mineral soil, limit the amount of encroaching vegetation, and require less preparation for the road to serve as a control line. The use of gated Forest roads as control lines for prescribed burning activities would not impact future use of these roads.

Closed roads that would not be needed for administrative vehicle use could also be utilized as control lines for prescribed burning activities. Without the periodic use from Forest staff, these roadbeds would slowly accumulate organic matter which would support the establishment and persistence of herbaceous and woody vegetation. The natural restoration of these roadbeds would occur slowly. This process would be set-back by the utilization of these areas for control lines, as mineral soil would be re-exposed and the encroaching vegetation removed. However, not all of the permanently closed roads would be used for control lines. These would go through the processes of natural restoration without further disturbance. Those identified as acceptable and necessary control lines would not go through the natural restoration processes until the prescribed burn sequences are completed. At that time, a determination would be made on the usefulness of keeping these lines in place as fuelbreaks.

The management of the transportation system would provide a 27% reduction in the road densities of the WRSNA. On the open county roads, motorized access would continue to be limited to the spring, summer, and fall seasons. Use of these roads by the public would continue to be primarily for recreational access, though direct motorized access to either the North or South Branches of the White River would be eliminated within the WRSNA. There would also be a reduction in the number of relatively isolated locations that users could access by motor vehicle and limitations on the number of locations for motorized-dependent camping. While the closing of Forest Service roads would reduce the impacts of motorized vehicles in some areas, it would also serve to increase the effects of motorized vehicles on (and adjacent to) the county road network in this area.

Horse travel on National Forest System lands in the WRSNA would be limited to a designated non-motorized trail system under Alternative 2 and prohibited under Alternative 3. As the Forest Service has no jurisdiction over the county roads, neither of these alternatives would exclude the use of horses on the county roads.

Under Alternative 2, all horse use in this area would occur on a designated trail. This trail would include a combination of an existing non-designated foot trail along the South Branch of the White River, existing Forest Service roads (that would be closed to motorized vehicles), and areas where new trail construction would be necessary. Of these, the placement of the trail on existing Forest Service roads would have the least effect. As historical travel routes, the existing Forest Service roads are already compacted, have exposed mineral soil, and have an adequate clearing width to become established as a non-motorized trail capable of withstanding high volumes of horse traffic.

While the horse use in this area is currently dispersed, Alternative 2 would concentrate all of this use onto the designated trail. Without mitigating actions on the existing roads, this concentrated horse use would likely result in portions of these roads becoming impassable to motor vehicles due to the displacement and loosening of the top layer of soil. The effects would

be similar to other locations within the WRSNA where concentrated horse use is occurring (i.e. Knapp Lake (FR5294) and the dispersed parking area off of FR5637). On the gated roads, this would affect accessibility to some areas for administrative use and the ability of some private landowners (under special-use permit) to access their property. On the permanently closed roads this would affect the natural restoration of these roadbeds due to the continued disturbance of the soils in these locations.

As the Forest Service roads would be closed off to motorized vehicles, there would not be conflicts between horses and motor vehicles on these roads under Alternative 2. These conflicts would still occur on the county road system, especially as both user groups would be concentrated. User-conflicts would also exist on the portions of the non-motorized trail system that occurs on the closed Forest Roads where mixed recreational use would be promoted. These conflicts would include horseback riders, hikers, and bikers. Without mitigating actions, there would be locations where the tread (resulting from horse use) and manure would make the designated trail in these locations difficult and/or unappealing for the other user groups.

Under Alternative 3, horse use would be prohibited within the WRSNA (with the exception of county roads) and there would not be a designated non-motorized trail established. All other forms of non-motorized recreation would be allowed throughout the area. As a result, the existing Forest Service roads (gated or permanently closed) would not be impacted by horse use. Gated roads would remain passable for administrative and private land access. Restoration of the permanently closed roads would continue to occur through natural processes. User-conflicts (relating to horse use) would be eliminated on National Forest System lands. These conflicts would be likely to increase on the county roads, as all of the motorized and horse traffic would be channeled on to the same road network. In addition, there would likely be a resulting deteriorating effect on the existing county roads throughout the area due to the combination of these concentrated uses.

In comparison: These alternatives would provide the minimum amount of motorized public access throughout the WRSNA. The resulting road density (1.0 miles/square mile) would be within the Forest Plan desired road density for Management Area 6.1 (0-1 miles/square mile) and would be in accordance with the Forest Plan Guideline to: "Close all Forest Service roads to motorized vehicles except for emergency and administrative use."

Alternatives 2 and 3

Management Area 4.4: Rural

Under these alternatives, there would be changes to three of the roads that are identified as open Forest Roads on the MVUM in the Otto portion of the Project Area. These are identified in the following table.

Table 3.42: Alternatives 2 and 3 Road System Proposals within the Otto Portion of the Project Area

Road Number	Existing Condition	Description	Alternatives 2 and 3 Desired Condition
FR9301	Open	This is a north/south road that runs north of Skeels Road and lies west of Sand Creek. All of the property bordering Sand Creek in this area is in private holdings where the road dead-ends and on-going management activities are in conflict with the existing location of the road.	This road would be eliminated from MVUM, gated, and put under a Special-Use Permit.
FR9320	Closed (not on the MVUM)	This is an east/west road that runs east off of 128th Avenue, before connecting with Kent Road on private property to the east.	Under Alternatives 2 and 3 the portion of this road on National Forest System lands would be added to the MVUM.
FR9310	Open	The segment of this road that is east of 142nd Avenue and west of FR9311 bisects areas that are proposed for savanna creation activities.	This segment would remain open to motor vehicles under Alternative 2 and be closed to motor vehicles under Alternative 3. It would remain part of the West Shore Snowmobile Trail, December 1-March 15, under both alternatives.

For Alternatives 2 and 3, the effects on the transportation system that would occur as a result of management activities would be similar to those discussed for Management Area 6.1. This would include the effects related to timber harvesting, savanna creation, and prescribed burning. Unauthorized travel routes (not on the MVUM) would be closed as time and resources allow. The methods of the closures and the resulting effects on the existing roadbeds would be similar to those discussed for Management Area 6.1.

Included in both of these alternatives would be the removal of FR9301 (0.4 miles) from the MVUM and the inclusion of the western portion of FR9320 (0.8 miles) to the MVUM. In addition to the resulting increase of 0.4 miles of open Forest Service road, these actions would also eliminate a dead-end spur that leads to private property (FR9301) and provide a road that would serve as a portion of a thru route from 128th to 142nd Avenue (FR9320). There would effectively be no change to the condition of these roads. A gate would be installed on FR9301 that would provide access for the private landowners to the north and for administrative use. As a result, the condition would be maintained to a similar or slightly better standard than the roads that would be gated under these alternatives in the WRSNA. Though FR9320 is not included on the MVUM as a part of the official transportation system, no efforts have yet been made to close this route. This, combined with past road improvements (i.e. gravel and culvert), have contributed to a high level of use. Incorporating it onto the MVUM would not alter the level of maintenance the road would receive or change the condition of the road; however, it would change its status from an illegal travel route to a classified road.

In the Otto portion of the Project Area, the only difference between Alternatives 2 and 3 would be in the use of the segment of FR9310 that is east of where it intersects with 142nd Avenue and west of where it intersects with FR9311. This portion of the road is a segment of the West Shore Snowmobile Trail. Under Alternative 2, this portion of FR9310 would be left open year-round.

In the spring, summer, and fall it would serve as a high-use road for motor vehicles. During the winter months it would continue to serve as part of the snowmobile trail. The use of this road would likely increase under Alternative 2 as a result of the decreased access within the WRSNA and the eventual closure of existing unclassified travel routes (not on the MVUM) used historically by those recreating in this area. Without mitigating action, this increase in use would lead to road widening, road surface degradation, and increases in noise, dust, and competition for the features associated with the road (i.e. dispersed campsites, parking areas, etc.). Due to the proximity of the savanna restoration activities to this portion of FR9310, protective measures would be taken to prevent road widening and the use of the savanna for motorized-dependent recreation. These measures would reduce, but not eliminate, these effects. There would be no effects associated with the use of this road as a snowmobile trail under Alternative 2.

Under Alternative 3, this portion of FR9310 would be closed to motor vehicles in the spring, summer, and fall. During the winter months it would continue to serve as part of the snowmobile trail. In closing this segment of FR9310 to motor vehicles, traffic in this area would be re-routed on a loop to the south that would include portions of FR9311, FR9870, and FR9309. None of the roads included in this loop were designed for the level of traffic that would be associated with this re-route and they are currently lacking in clearing width, site-distance, and adequate areas to pull-off. Developing this loop as a thru route would require major vegetative clearing, shaping and filling, surface hardening, and the development of adequate pull-offs. Once these improvements were complete, the loop would be susceptible to traffic congestion and the areas of savanna restoration along this route would be at risk from the effects of motorized-dependent recreation due to the topography, localized vegetative and soil conditions, and the existing road layout.

The roads (and their associated features) within Otto would receive increased use under both of the action alternatives. This would be a result of the road closures in the WRSNA and closures of the travel routes not on MVUM. Of the Forest Service roads that would remain open, most were not designed for the high volumes of traffic that would occur under Alternative 2 or 3. With the closure of the Forest Service roads in the WRSNA, displaced motorized users from that area would be likely to attempt to move into this area to fulfill their recreation needs. Likewise, those users that have historically recreated within this area on roads that are no longer open (not on MVUM) would be displaced to new locations to fulfill their recreation needs. The recreational draw to this area is the North, South and Main Branches of the White River. Historical users of this area would be likely to want to stay in relative proximity to these. As a result, there would be an increase in the number of displaced motorized users attempting to utilize a decreasing or available area open for that use. This scenario would put pressures on the road system in this area that the system was not designed to accommodate. Socially, these pressures would lead to increased levels of congestion, noise, and user-conflicts. Physically, these pressures would lead to increases in road width, road braiding, the softening of the road surface, and the presence of features commonly associated with the roads in this area (i.e. dispersed campsites, parking areas, etc).

In comparison: Alternative 2 would provide more total open roads than Alternatives 1 or 3 at 24.3 miles (8.9 miles of Forest Service roads), with a final road density of 2.1 miles/square mile. Alternative 3 would provide the least amount of total open roads at 23.6 miles (8.2 miles of Forests Service roads) with a final

road density of 2.0 miles/square mile. Both alternatives would be within the Forest Plan desired road density for Management Area 4.4 (0-3 miles/square mile).

(3.14d) Cumulative Effects

The management of the transportation system within the Project Area involves a combination of county, federal, and private roads. These roads combine to form a network that provides motorized (and non-motorized) access to both public and private lands throughout the Project Area. This will not change in the reasonably foreseeable future.

The Forest Service has no jurisdiction over the roads that are claimed by either Oceana or Muskegon County. These roads include a combination of seasonal roads and roads that are maintained to varying degrees throughout the year by the Road Commissions. The Project Area encompasses approximately 15,000 acres of National Forest System lands. This represents approximately 23% of the total National Forest System lands within these counties (~65,900 acres) and 1.5% of the total National Forest System lands that make up the HMNF (~978,000 acres).

None of the alternatives for this project would include any proposals for the management of the County road system; including those roads in the WRSNA. However, under Alternatives 2 and 3 there would likely be increased use of the county road system in the semiprimitive area in response to the closure of the remaining Forest Service roads. These closures would also be likely to cause increased use on the County roads in other portions of the Project Area and in the other areas that are outside of, but adjacent to, the Project Area. This increase in use would not only be from motorized vehicles, but there would also likely be increases in the amount of horse traffic that occurs on these roads. This would be higher under Alternative 3, as there would be no other place within the WRSNA that horse traffic would be allowed. Under Alternatives 2 and 3, increased horse use on county roads could also be anticipated in other areas within the Project Area and in areas that are immediately adjacent. As a result of these alternatives, the WRSNA area would eventually be utilized more for non-motorized recreation activities (i.e. hiking, bird watching, etc.), though these experiences would be impacted by the continued presence of the county roads within the area. Within the WRSNA, the decrease in road densities would increase the value of the area for those who prefer less interaction with motorized vehicles.

Within this Project Area, the existing Forest Service road system plays an important role in how people have historically and currently utilize the National Forest. Alternatives 2 and 3 would change this use through implementing changes to this system. With this change, there would be social impacts. The social aspects would be related primarily to the reduction in motorized access to the WRSNA. This would impact not only those who historically and currently have used this area for motorized-dependent recreation (i.e. dispersed camping, driving for pleasure, etc.), but also those who have utilized adjacent areas. It would be anticipated that as a result of Alternatives 2 and 3, there would be an increase in this type of use in the adjacent areas by those who are displaced from the WRSNA. Many of the visitors that currently use this area and prefer or require motorized recreation would be likely to move to other locations if the roads closed under these alternatives impact the areas where they have traditionally recreated. These areas are provided in many of the other Management Areas that are part of the HMNF.

Throughout this Project Area, there is historical evidence of the changes to the transportation system that have occurred over time and the fragmenting effects to the ecosystem that roads have had. These effects range from old roadbeds that are barely visible on the landscape to recent hill-climb areas where the mineral soil is freshly exposed. The development of the road system in this area is a relic of not only past forest management activities (i.e. timber harvesting and hauling, fire suppression, etc.), but also the shifts in motorized use patterns by the public. Throughout the Project Area, these patterns have been consistent with other areas on the Forest. Anecdotal factors that may be contributing to these shifts include: 1) increases in the human population adjacent to the Project Area, 2) decreases in the size of contiguous private ownership, 3) increases in the availability and type of motorized vehicles, and 4) increases in the age of the population and their related dependence on motorized transport.

In the reasonably foreseeable future, the National Forest System lands within the Project Area will continue to be fragmented by both private in-holdings and the presence of roads on the landscape. It is expected that as human population pressures in the adjacent areas increase, the size of individual landholdings will decrease. This will cause an overall increase in private land fragmentation and a diversity of private land uses in and around the Project Area. The result of this trend will likely be an increase in the use of National Forest System lands for recreation. With the current and anticipated use of motor vehicles and ORVs for recreation, there will likely be an increased amount of use by these vehicles on the road systems of National Forest System lands.

The combination of the roads that existed on the landscape prior to becoming part of National Forest System lands, roads that were designed and developed to conduct management activities on the Forest, user-created roads, and roads that are under the jurisdiction of others (i.e. county and private) have resulted in a Project Area where Forest users are rarely greater than ½ mile from some sort of road. This is consistent with other portions of the Forest as the following table illustrates.

Table 3.43: Proximity of HMNF Lands to Existing Roads

Forest Unit	Total Acres	Acres within ¼ Mile of Road	Acres within ½ Mile of Road
Manistee National Forest	538,700	418,300 (78%)	519,500 (96%)
Huron National Forest	439,700	294,700 (67%)	400,300 (91%)
Total	978,400	713,000 (73%)	919,800 (94%)

Forest and county-maintained roads will continue to be utilized to conduct management activities throughout the Project Areas under all of the alternatives. Improvements will be necessary on some of these roads in order to accommodate these management activities. The level of improvements that are maintained will vary based on the existing and anticipated use of the road at the time of improvement. The end result will be an improved transportation system that is in accordance with Forest Plan direction (2006) and that provides for both public and administrative use.

(3.15) Economics

(3.15a) Existing Condition and Resource Specific Information

Unlike other resource areas that are addressed in this assessment, the effects that this project would have on the economy are more difficult to quantify. This is because local economic trends are influenced by a wide variety of factors that extend beyond the local level. While deciding to implement specific activities may have obvious quantifiable economic effects in the short-term (i.e. the amount of timber harvested at the current market rates), how these activities may impact the economy in the long-term (i.e. shifts in preferred recreational use) can only be estimated.

Traditionally, the timber and recreation resources on the Manistee National Forest contribute to the economic well-being of the communities in northwest Michigan. For example, timber harvesting and other associated projects on the National Forest affect the local economy by supplying timber to local mills, providing employment to local contractors to harvest the timber, and employing other contractors to complete reforestation, road work, and wildlife related work.

In addition, the presence of public lands in Oceana and Muskegon counties also generates service related employment and the income that is commonly associated with seasonal resident and tourism spending. This employment ranges from the support businesses (i.e., gas stations and grocery stores) in the local towns and villages (i.e., Hesperia and Whitehall) to the local homeowner that sells firewood to those coming into these areas to recreate.

(3.15b) Area of Analysis

The area of analysis for the direct and indirect effects on the economy is the Project Area, and the adjacent lands within 50 miles of the Project Area. This represents a typical commuting distance for those who may be employed in the implementation of the proposed activities and a reasonable customer base radius for business owners that may be potentially impacted. The area of analysis for the cumulative effects on the economy is northern Lower Michigan. This large area represents the supply of wood raw materials to manufacturers of forest products, and also corresponds to the location of the range of recreational opportunities favored by Forest users and tourists.

(3.15c) Direct and Indirect Effects

Alternative 1

This alternative would not generate revenues for the U.S. Treasury from the sale of timber raw materials. Employment opportunities arising from timber harvesting, wood products, and restorative habitat improvement projects would not occur within the Project Area. There would be continued costs associated with the maintenance of the existing road closures and the implementation of the projects that are already on-going within the Project Area. These projects include two savanna restoration projects that were part of previous decisions and the

restoration of several sites where ORV damage has occurred along the White River in Otto Township. Indirectly, this alternative would contribute to increased costs to the Forest associated with the continued law enforcement and patrol of areas left open to motor-vehicle access within the SPNMA. These costs would not vary between alternatives in other portions of the Project Area, as the existing road system would remain mostly intact.

There would be no direct effects to the existing recreational use within the Project Area under this alternative. The existing transportation system would remain in place (consistent with the MVUM). This system would continue to provide dispersed access points to the river and dispersed campsites along the existing roads. Horse use would continue to be allowed throughout the Project Area. This continued use would contribute to the local economy through the indirect support of local businesses and, to a lesser extent, local private landowners that provide the goods and services related to the tourism and recreational industries.

Alternatives 2 and 3

Under Alternatives 2 and 3, commercial timber harvesting activities would return money from the U.S. Treasury to Oceana and Muskegon Counties for use in education and road maintenance. Timber sale activities have preparation and administration costs, such as employee wages, road construction, and the regeneration of harvested areas that would remain classified as commercial forest land. The amount of income from timber sales is variable based on the type, quality, and quantity of timber. Typically, timber sales produce revenue which is then utilized to conduct other management actities that are within the Project Area. Additional funds that are generated are then returned to the U.S. Treasury.

The timber that is within this Project Area that would be harvested under these alternatives would not be likely to produce enough funds to cover the combined cost of doing this analysis and preparing the sale areas (layout, road improvements, timber marking, etc.). Additional funding would be necessary to accomplish the program of work that would be necessary to accomplish the successful restoration of the savanna ecosystem in this area. Due to the adaptive management approach that is used for these activities, the costs associated with these activities are extremely variable. For example, two adjacent areas would likely requre different levels of treatments (both in type and scale) to successfully bring the restoration to completion. While prescribed burning alone may be sufficient at one site, an adjacent site may require tree harvesting, tree and stump removal, prescribed burning, and the seeding in of native vegetation. As a result of the differences in these types of treatments, the costs can vary considerably.

The closing of roads within the SPNMA would cause a shift in the type of recreational use within this area. The majority of existing use in this area is dependent on motorized vehicle access, either directly (i.e. driving for pleasure) or indirectly (i.e. the hauling of campers or horse rigs). Limiting the motorized access in this area to the existing county roads would change the recreational experience in this area. As a result, some of the existing motorized-dependent users would likely make a choice to go to other locations both inside and outside of the Project Area. In the short-term, this shift would likely have minor economic impacts for those that are immediately adjacent to the Project Area; however, these impacts would not be likely to extend beyond the boundaries of this analysis (50 mile radius). These impacts would be more

pronounced under Alternative 3, as horse use would be limited to areas outside of the SPNMA. Again, this use would also be likely to shift to other locations of the Forest and be unlikely to have major economic impacts that would extend beyond the analysis boundary.

In other areas throughout the Project Area, the short-term recreation use on the Forest would be displaced during harvesting operations and periodically thereafter during the follow-up restoration treatments. This displacement would not have lasting economic impacts within the analysis boundary, as users would likely move to other adjacent areas on the Forest during the period of displacement.

Table 3.44 measures financial effeciency, and only includes average FY 2010 Forests' program costs and market-based values (revenues received directly) for Alternatives 2 and 3. The Forests' Plan and DEIS measure economic efficiency using present net value, which compares the discounted benefits and the costs of market and non-market resources. Non-market resource values predominant in the Project Area include hunting, fishing, horseback riding, camping, picnicking, and viewing wildlife; however, a present net value is not calculated because these resources have values assigned at scales larger than the Project Area. In general, non-market values between Alternatives 2 and 3 are equivalent, where a change in scenic attractiveness is offset by restoring recreation sites and early habitat production, which particularly increases game wildlife viewing opportunities.

Table 3.44 displays costs and revenues for Alternatives 2 and 3 for the timber harvesting activities and the required payments of the Project. The values included in this table are estimates based on those areas where timber resources may be of commercial quality and quantity.

Table 3.44: Estimated Revenues and Costs for Harvest Activities

Activity/Unit Cost	**Alternatives 2 and 3**
Acres Harvested	3015
Sale of Stumpage Revenue	$799,000
NEPA Development	$170,000
Timber Sale Preparation	$400,000
Estimated Road Improvement Costs	$50,000
Locate Land Lines	$50,000
Reforestation Surveys	$500
Total Costs	**$670,500**
25% Fund Payment	**$200,000**
Net Revenue	**$(71,500)**

**Parentheses indicate a negative value.*

In addition to the costs and revenues associated with timber harvesting activities, this project would have costs associated with the creation/restoration of areas to savanna. These activities would be adaptive in nature, meaning that follow-up treatments would be based on the results of previous treatments, based on monitoring. As a result, determining an exact cost for the creation/restoration of savanna is not possible. The values that are shown in *Table 3.45: Non-timber Related Costs for the Savanna Ecosystem Restoration Project* are estimated values based on the initial treatment and do not take into consideration whether the work is carried out by

Forest Service personnel or is accomplished through the use of a private contractor. As a result, the values would likely vary greatly from what is shown. Factors that may affect the cost of implementing these activities are described below:

1. *Savanna Restoration/Creation Site Preparation:* The type and amount of site preparation that would be necessary in any given stand would be dependent on the existing condition of that stand. The types of activities would include, but not be limited to: stump removal, leveling/grading, chipping, masticating, and discing. The purpose of these activities would be to prepare the soil for the establishment of the native seed patches that would not exceed 10% of the treatment areas. The value that is shown for this assumes that no more than 10% of the areas being converted/restored to savanna would require site preparation and that site preparation would only need to occur once.

2. *Prescribed Burning:* The cost-effectiveness of this activity increases with the amount of area that can be incorporated per burn (i.e. larger burns are more cost-effective than smaller burns on a per unit basis). Larger burns can reduce the cost per acre by utilizing already established containment lines (i.e. roads), reducing mobilization (i.e. equipment and personnel), and the number of required individual burn plans. Under Alternatives 2 and 3, all of the units proposed for savanna creation/restoration would include the use of prescribed burning as a tool for establishment and maintenance. Other areas have also been included to meet other management objectives and to reduce the cost/unit of implementing the prescribed burning activities. While it would be expected that many of the areas proposed for savanna creation/restoration would require multiple burns to meet the desired future condition, the costs that are shown for burn activities are reflective of only one burn per unit. This is the minimum that would be required.

3. *Seeding of Native Plants:* Under Alternatives 2 and 3, the seeding of native plants would occur in the same locations as, but following, site-preparation. This area would not be expected to exceed 10% of the total area proposed for savanna restoration/creation. The amount and type of native seed that would be used in these areas is variable and largely dependent on what emerges from the existing soil seedbank. The cost of native seed is also variable. The value of seed displayed in Table 3.45 is intended to be used as an average, with a seeding rate of 10 lb/acre.

4. *Herbicide Non-Woody Vegetation/NNIS:* Under Alternatives 2 and 3, these treatments would occur on the 10% of the areas proposed for savanna creation/restoration and in the control of the NNIS that has already been identified through botanical surveys. It would be likely that the areas where NNIS control would be necessary would increase in the savanna creation/restoration areas due to an increase in sunlight, disturbance to the upper soil profiles, and NNIS seeds present (but currently dormant) in the seed bank. As a result, the cost to contain/control these species would likely increase beyond the level of the initial treatments that are reflected in Table 3.45.

5. *Herbicide Woody Vegetation:* This activity would apply to the areas under Alternatives 2 and 3 where savanna creation and opening restoration would occur. The implementation would consist of spot-treatment of sprouting stumps, with the amount required dependent on the number and type of stumps per acre. For example, it would

be expected that the amount of stumps treated in the pine stands and open areas would be less than that of existing forested oak stands. How much would depend on the existing location and cover type characteristics. The value that is reflected in Table 3.45 assumes that all of the stands would require approximately the same level of treatment and that the treatments would be necessary on every acre that is proposed for treatment.

6. *Road Decommissioning or Gating:* The costs associated with closing and decommissioning roads would vary by the type of closure. For example, at one location a gate may be sufficient, while at another location the gate may need to be re-enforced with barrier posts. For this project, all of the roads that would be closed would also be needed for future administrative purposes (i.e. conducting KBB management activities or special-use access). As a result, locked gates, in conjunction with barrier posts, would be the initial preferred method of closure.

7. *Horse Trail Design and Construction:* The costs associated with the design and construction of a non-motorized trail within the White River Semi-Primitive Non-Motorized Area would only apply to Alternative 2. While portions of the trail would incur little to no expense to implement (i.e. existing trail or roads), the portions of the trail where new construction would be necessary would require economic inputs (i.e. along existing county roads and to avoid existing KBB habitat). The costs that are reflected refer to those portions of the trail where new construction would be necessary.

8. *Parking Lot Development:* Under Alternative 2, economic inputs would be required for the construction of two parking areas. One parking area (south of Arthur Road) would be designed and constructed to facilitate use by those utilizing the White River Semi-Primitive Non-Motorized Area for horseback riding. As such, this parking area would be designed to accommodate multiple large horse rigs. The second parking area (east end of Winston) would be designed to provide adequate parking and use by multiple full size vehicles for recreationists. This parking area would be in close proximity to the river (<1/4 mile). The inputs required for both parking areas would include excavation, surface hardening, and containment. Under Alternative 3, only the Winston Road parking area would be developed. Of the two, the inputs required for the Winston parking area would be less than the parking lot south of Arthur Road.

9. *Campsite Development:* The designation of 11 dispersed campsites within the White River Semi-Primitive Non-Motorized Area would occur under both of the action alternatives. As dispersed campsites, there would be little economic inputs anticipated in the form of improvements. However, there would be costs associated with clearing new sites, installing perimeter and site posts, and signage. The estimated amount necessary to cover these costs are shown in the table.

Table 3.45: Non-timber Related Costs for the Savanna Ecosystem Restoration Project

Activity[1]	Estimated Measure		Estimated Amount per Acre	Total By Alternative	
	Alternative 2	Alternative 3		Alternative 2	Alternative 3
Prescribed Burning (acres)	4,111	4,111	$150	$616,650	$616,650
Site Prep/Seeding of Native Plants (acres)	306	306	$3,000	$918,000	$918,000
Herbicide Non-woody Vegetation/NNIS (acres)	345	345	$400	$138,000	$138,000
Herbicide Woody Vegetation (acres)	3,061	3,061	$400	$1,224,400	$1,224,400
Road Decommissioning or Gating (gates)	8	10	$1,000	$8,000	$10,000
Design and Construction of the Non-motorized Trail System (miles)	12.2 miles new construction of single-track trail	0	$1,000 per mile of new construction	$12,200	0
	7.5 miles designated on closed forest roads.	0	$200 per mile of designation	$1,500	0
Parking Lot Development	1 Horse Parking Area	No Horse Parking Area	$120,000 Total Cost	$122,500	$2,500
	1 Angler Parking Area	1 Angler Parking Area	$2,500 Total Cost		
Campsite Development ($1,000/site)	11	11	1,000	$11,000	$11,000

[1]*Calculations for these activities are based on the maximum potential area treated. Actual costs for these activities would vary by the effectiveness of treatments and the results of monitoring.*

(3.15d) Cumulative Effects

Alternative 1

Taking no action within the Project Area would provide no additional employment and income, other than that available under the prevailing general conditions within Northern Lower Michigan. No timber harvesting in the Project Area would most likely shift these effects to other areas where an equivalent amount of employment opportunity occurs. Payments from the 25% Fund that would be generated by implementing Alternatives 2 and 3 would shift away from Oceana and Muskegon Counties. As the existing forested stands would remain classified as such, these areas would be eligible for commercial harvesting entries in the future. Payments to the respective counties would be deferred until the time when harvesting activities occurred.

The Forest would continue to provide wood products as opportunities arise in the reasonably foreseeable future. The harvesting and use of these products would continue to be influenced by supply and demand. Historically, the price of timber increases as the demand increases. During these times, the amount of harvesting that occurs on private land also increases. Conversely, timber prices decrease as demand decreases. During these times, the amount of harvesting that occurs on private lands also decreases. While the availability of timber on National Forest System lands would remain consistent, the revenue generated from the sale of timber would continue to fluctuate with the market demand.

Timber harvesting in Northern Lower Michigan accounted for 40% of the State's industrial roundwood and 52% of its saw log production in 1998 (USDA Forest Service 2003). A current search of the MDNRE forest products database lists 544 reported businesses that employ personnel connected to the procurement, processing, and manufacture of wood products in the northern lower peninsula of Michigan (MDNRE, 2010). This is an increase of 10 businesses since 2008, though it is unclear if this increase is due to better reporting or an actual net increase in the total. Within the recent past, two large pulp mills have closed or reduced production, largely for competitive business reasons (Traverse City Record Eagle 2006).

These events have reduced the total employment in the timber harvesting and manufacturing sectors by a significant factor in Northern Lower Michigan. The competitive, global nature of the paper industry will likely reduce employment in pulp mills in the future; however, employment in saw mills will decline at a smaller rate due steady saw log production levels and fewer capital investments (Leefers 2006). A decrease of over 22,000 or 25% of the forest product industry jobs were lost between 2000 and 2004 with only 99 of these job losses from the logging and forestry category which is less than 5% of this category (Berghorn 2005)

Opportunities for recreation would continue to be provided on private and public lands within the Project Area and throughout Northern Lower Michigan. While the exact locations and types of recreation that people engage in throughout the region is impossible to predict, this part of Michigan has an economy that is based on providing goods and services in support of recreational tourism throughout the year. This would not change as a result of this project.

Property values throughout Northern Michigan fluctuate greatly based on the type of land, the location, and the use. The existing land-use mosaic includes the following trends: 1) urban areas are expanding, with adjacent areas that were formerly larger blocks of contiguous ownership being broken up into smaller parcels; 2) areas with soils capable of sustaining agriculture are still in production; 3) areas without soils capable of sustaining agriculture remain in a forested, open, or developed condition; 4) few large tracts of private land remain in single ownership; 5) public lands remain largely fragmented by private ownership; and 6) private property within the Forest boundary (and adjacent to waterways) includes seasonal homes or non-homestead property.

Fluctuations in property values may occur due to local, state, or national market trends and as a result of the site-specific characteristics of individual properties. Individual consumers have little control over the market trends in real estate. The site-specific values associated with individual properties are in some ways related to personal preference. For example, one person may place more value on a solitary dwelling in a country setting, while another may place more

value on an urban dwelling with neighbors close by. Therefore, management activities that affect an existing environment may decrease the value of that environment to one landowner and increase the value of the environment to another. This alternative would continue to provide adjacent landowners with an environment that is consistent with what has been present historically.

Alternatives 2 and 3

Under Alternatives 2 and 3, there would be additional employment opportunities associated with timber harvesting activities and the creation and restoration of the savanna ecosystem. Employment opportunities would likely be in the form of contractors and seasonal and permanent staff. Included would be such activities as: timber sale layout and administration, timber harvesting, timber stand site preparation, regeneration surveys, savanna site preparation, NNIS/savanna herbicide application, seeding and planting, road and parking lot construction and maintenance, and wildlife surveys. Further contributions to the economy would occur through the purchasing of materials and supplies necessary to accomplish the work. These activities would occur over a period of up to 10 years and, when compared with the economy of Northern Lower Michigan, would have little to no impact on the prevailing conditions.

In addition to the projects that would be implemented under Alternatives 2 and 3, other similar types of projects would also be likely to occur within this Project Area and in other locations of the HMNF. These projects would also contribute to the economy of Northern Lower Michigan and would likely have beneficial cumulative effects on the public and private natural resource management sector.

In addition, the implementation of either of these alternatives would provide payments from the 25% Fund which would be used to assist in the funding of improved transportation systems and education within the counties where treatment activities are proposed. These same types of funds would be available to other counties where similar types of projects occur. While individual projects would likely have only a small impact on the respective county coffers, cumulatively the income generated from the 25% Fund could serve as an important supplement in counties that have been hit the hardest by the recent economic downturn.

Under Alternatives 2 and 3, the acres receiving savanna creation/restoration treatment would be removed from the suitable commercial forest land base of the Forests. While the respective counties would receive payments as a result of the receipts from this project, similar payments from the savanna creation/restoration areas would not occur in the future. This loss of income would likely be off-set by payments from the 25% Fund as a result of other harvesting activities occurring in areas of the Forest that remain part of the commercial base. Currently, the Forest has approximately 400,000 acres of land suitable for timber management to meet the allowable sale quantity (ASQ) for the first decade. This equates to 15.2 million cubic feet per year (FEIS Appendix A and H). Forested timberlands are those which produce a minimum of 20 cubic feet of fiber/acre/year and that are currently not withdrawn from timber production. Approximately 380,000 acres of forested timberlands are required to meet the current ASQ. The remaining Forest lands are not targeted for timber production, but are anticipated to contribute some timber volume that does not contribute to the ASQ in the next 20 years. In conjunction

with Project Area non-timber resources, Alternatives 2 and 3 contribute to the positive increase of Non-market Present Net Values in the Table III-54 in the FEIS.

Under Alternatives 2 and 3, opportunities for recreation would continue to be provided on both private and public lands within the Project Area and throughout Northern Lower Michigan. While the exact locations, types, and future trends of recreational use throughout the region is impossible to predict, this part of Michigan has an economy that is based on providing goods and services in support of recreational tourism throughout the year. This would not change as a result of this project.

As a result of the activities associated with the creation and restoration of savanna, Alternatives 2 and 3 would alter the viewshed of adjacent private landowners within portions of the Project Area. While these changes may impact the perceived property values to the existing private landowners, there may be others who would prefer the viewshed that will be created. The projects proposed under these alternatives are not expected to cause fluctuations in the values of real estate within or adjacent to the Project Area, especially when compared with occurring trends across the Northern Lower Peninsula of Michigan.

Other cumulative economic effects would be similar to those discussed under Alternative 1.

Conclusion: The duration and magnitude of either Alternatives 1, 2, or 3 will not incrementally add to past, present and reasonably foreseeable economic forces and events within the Manistee National Forest, primarily because the Forest contributes less than 2% of the employment and income effect to the local economy.

(3.16) Heritage Resources

(3.16a) Existing Condition and Resource-Specific Information

Introduction

The glacial retreat (approximately 11,000 years before present (BP)) allowed for the utilization and settlement of Lower Michigan by mankind for the past 9,000 years. The Paleo-Indian cultures that occupied this area consisted of hunter and hunter-gatherer groups who followed the migrating animal herds through the open grasslands that became established with the glacial retreat. Hunter-gatherers are people whose subsistence strategy (food, shelter and supplies) was based on seasonal animal migration and wild plant collection for foodstuffs, clothing, cordage (twine and rope), and chert for stone tools. Warming trends allowed for changes in flora and fauna, and by 8,000BP the open grasslands began transitioning to pine forests that were utilized by Early and Middle Archaic cultures of hunter-gatherers (Branstner 1991). The environment developed into its modern biotic communities by 3,500BP (Fitting 1975). This lead to a transition marked by the Late Archaic and Woodland cultures, who became more settled, establishing semi-permanent and permanent encampments, territories, and trading centers. These cultures started to mold their environment and by 2,000BP developed agriculture to supplement and then partially replace their dependence on seasonal foraging strategies.

European explorers began arriving in the Great Lakes Region by 400BP, marking the beginning of the Historic Period. These Europeans established trading centers and conducted fur trapping and trading with the indigenous peoples and introduced them to European goods and ideas. European settlement of Lower Michigan began in earnest by 150BP with the introduction of large scale logging operations and homesteading. By 20BP (1930A.D.), the forests of Michigan were depleted and a majority of homesteads were abandoned due to poor soils, fire danger, and the Great Depression. The Manistee National Forest was established during this time through the acquisition of these abandoned lands. The Civilian Conservation Corps (CCC) was created at the same time to employ the nation. The work accomplished by the CCC in Michigan included planting trees, controlling soil erosion, and repairing damaged riparian areas. In addition, the CCC constructed water control structures and assisted in the development of recreational facilities throughout the state.

Throughout this era of occupation and utilization, people left physical evidence of their presence. This evidence includes stone implements and waste material, pottery, structural remains, maintained structures, metal implements, and glass. To be considered historic, features and artifacts must be at least 50 years old or have a significant impact on the culture (such as the CCC). Otherwise, the term "archaeological resource" means any material remains of past human life or activities which are of archaeological interest, as determined under uniform regulations pursuant to the Archaeological Resources Protection Act of 1979. Such regulations containing such determination shall include, but not be limited to: pottery, basketry, bottles, weapons, weapon projectiles, tools, structures or portions of structures, pit houses, rock paintings, rock carvings, intaglios, graves, human skeletal materials, or any portion or piece of any of the foregoing items. Non-fossilized and fossilized paleontological specimens, or any

portion or piece thereof, shall not be considered archaeological resources, unless found in an archaeological context. When identified through field survey, archeological "heritage" resources are documented and protected in accordance with the National Historic Preservation Act of 1966, Archeological Resource Protection Act of 1979 and various Forest Service directives.

Existing Condition

The Project Area has a very high probability for the presence of both historic and prehistoric cultural resources. Portions of the North, South, and Main Branches of the White River and its tributaries (Mud Creek, Sand Creek, Knutson Creek and Knapp Lake) are all included within the Project Area boundaries. Associated with these water bodies are approximately 20 miles of river bluff, stream bank, and lake edge that occur entirely or within ¼ mile of the Project Area.

Prior to European contact, the White River (and its tributaries) and the adjacent areas were utilized by the indigenous peoples for residence, sustenance, travel, and trade. In addition, European settlers utilized this river and its tributaries for logging, travel, and trade. While there is the potential for extensive cultural resources along this waterway, only a small portion of it (<1 mile) has been recently intensively surveyed within the Project Area. There have been 26 previous surveys conducted within the Project Area. The combined surveys have resulted in the identification of 20 known cultural resources within the Project Area and 54 known cultural resources located within 1 mile of the Project Area.

Of the 20 known heritage resource sites, there is one prehistoric site and nineteen historic sites. The prehistoric site consists of a Woodland period encampment. The historic sites include: 1 historic grave, 1 logging camp, 1 artifact scatter, and 16 homesteads or farms. Eligibility of these 20 sites to the National Register of Historic Places (NRHP) consists of 19 sites that are currently Unevaluated, and 1 site listed as Not Eligible to the NRHP.

The 54 known cultural resources located within one mile include 35 historic sites and 19 prehistoric sites. Of the historic sites, there are 19 homesteads/farms, 4 schools, 3 artifact scatters, 2 sawmills, 2 historic areas/villages, 2 historic depressions, 1 logging camp, 1 lookout tower, and 1 cemetery/school. The prehistoric sites consist of 7 Woodland period camps/villages, 5 lithic concentrations, 2 pottery concentrations, 2 lithic/ceramic concentrations, 1 lithic scatter, 1 pottery scatter, and 1 Archaic/Woodland period camp. A total of 4 sites are listed as Eligible to the NRHP, 1 is listed as Not Eligible, and there are 49 sites listed as Unevaluated to the NRHP.

Methods and Findings

Based on the proposed activities within the Project Area, the cultural resource area of impact is 4,805 acres. Of this area, there are 3,451 acres that were previously surveyed. The total amount of survey necessary to complete the project consisted of 1,384 acres. Survey coverage was accomplished utilizing a combination of Rule 4 and 5, pedestrian transect surveys. During this survey, 15 new sites were identified. There are 2 logging camps, 11 homesteads/farms and 2 historic depressions. In addition to the pedestrian transect survey, 1.2 acres of intensified survey (shovel testing) was conducted utilizing a 10m x 10m grid on 3 transects. There were 5

positive shovel test units, identifying 1 new prehistoric site. In addition to the recorded features, the survey crew located 5 cultural features that did not meet the criteria for a cultural resource site. These five cultural features included a dugout depression, a 1930's household dump, a 1950's household dump, and 2 can dumps from 1930-1985.

(3.16b) Direct, Indirect, and Cumulative Effects

Under Alternative 1, no management activities would occur within the Project Area as a result of this project. The potential impacts would be limited to those projects that are on-going within this area. These areas have been surveyed and conservation measures established to minimize any impacts on the cultural resources. In addition, some sites would remain vulnerable to being inadvertantly impacted by recreational or administrative use. These impacts occur rarely and are difficult to predict, but are historically minor in severity and limited to the surface layers of the existing sites.

Under Alternatives 2 and 3, the potential impacts to the cultural resource sites consist of ground disturbance activities from prescribed fire line construction, mechanized tree harvesting, and mechanical equipment associated with the establishment and maintenance of savanna (i.e. stump removal, soil scarification, planting, etc.). Potential impact damage would range from minor (soil compaction and surface scraping) to severe (site obliteration). Under these alternatives, implementation would occur in several phases. Based on the extent of proposed ground disturbance, all of the areas proposed for savanna creation and KBB opening restoration would be subject to Rule 4 (30 meter or better surface) survey coverage prior to project implementation. Conservation measures have been established (see see the CR section of Appendix A) to ensure minimal impact to the cultural resoure sites that have been or are identified.

In addition, there are fifteen locations within the Project Area that would require intensive survey (shovel testing) prior to the implementation of the activities proposed under Alternatives 2 and 3. These locations would be established as cultural resource reserve areas, in which ground disturbance prescriptions would be restricted or disallowed until the intensive survey is completed. Avoiding sites and cultural resource reserve areas would protect the sites and reserve areas from ground disturbing impacts and ensure that these areas would not be damaged or destroyed. Allowing prescribed burning over select cultural resource sites would allow for the sites to better blend into the newly established savanna and opening system. Prescribed burning would also help remove hazardous heavy fuel loads from within site boundaries, better preserving site integrity. If unknown cultural resources are discovered during project activities for the proposed project or if there is a change in the locations of treatments, then a professional Cultural Resources Specialist would be contacted. Project work would not be allowed to resume until the cultural resources have been documented and the sites are preserved from any potential impacts.

The implementation of these recommendations will remove all potentially adverse impacts to cultural resources for this project.

(3.17) Environmental Justice

(3.17a) Existing Condition and Resource-Specific Information

Forest Service activities must be conducted in a discrimination-free atmosphere. Contract work that may be generated from this project would include specific clauses offering civil rights protection. The Forest Service would make a concerted effort to enforce these policies. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups should bear disproportionately high and adverse human health or environmental effects resulting from Federal agency programs, policies, and activities. Environmental justice is also the identification of projects that are located near minority and low-income communities that have an adverse environmental impact. The purpose of the evaluation is to determine if a disproportional number of projects that have adverse environmental effects are located near minority and low-income communities. The following table highlights the differences in demographic trends between Michigan and Oceana and Muskegon Counties.

Table 3.46: Demographic Trends within the Area of Analysis

Factor	Measure	Oceana County	Muskegon County	Michigan
Population, 2009 estimate	Number	27,577	173,951	9,969,727
Population, April 1, 2000 to July 1, 2009	Percent Change	+2.6%	+2.2%	+0.3%
Persons 65 years old and over, 2008	Percent	15.2%	12.9%	12.8%
Female persons, 2008	Percent	49.8%	50.3%	50.8%
White persons, 2008	Percent	96.8%	83.3%	81.2%
Black persons, 2008	Percent	0.6%	13.4%	14.2%
American Indian and Alaska Native persons, 2008	Percent	1.1%	0.8%	0.6%
Asian, persons, 2008	Percent	0.3%	0.8%	2.4%
Persons of Hispanic or Latino Origin, 2008	Percent	14.9%	4.5%	4.1%
Persons reporting two or more races, 2008	Percent	1.2%	1.9%	1.5%
Foreign born persons, 2000	Percent	4.4%	1.9%	5.3%
Language other than English spoken at home, age +5, 2000	Percent	11.5%	4.4%	8.4%
High school graduates, age 25+, 2000	Percent	79.8%	83.1%	83.4%
Persons with a disability, age 5+, 2000	Number	5,338	34,257	1,711,231
Households, 2000	Number	9,778	63,330	3,785,661
Median household income, 2008	Amount	$40,872	$41,274	$48,606
Persons below poverty level, 2008	Percent	18.8%	17.9%	14.4%

The values presented in this table were compiled by the U.S. Census Bureau and are accessible on-line at: http://quickfacts.census.gov/qfd/states/260000.html.

This information indicates that Oceana and Muskegon Counties do not qualify as environmental justice communities. None of the alternatives are expected to disproportionately impact human populations. There are no human health or safety factors associated with the alternatives that would affect low-income or minority populations in or around the Project Area.

Local tribes were scoped during the development of this project.

(3.17b) Area of Analysis

Environmental justice is a community measurement of a variety of socio-economic factors in comparison to a baseline of similar data. For this project, the data from Oceana and Muskegon counties was compared with the State of Michigan.

(3.17c) Effects Common to All Alternatives

No alternatives are expected to affect the civil rights of any landowners, or other individuals, near the Project Area. Any contracts would be issued in accordance with USDA regulations. There would be no discrimination based on race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. The laws, rules, and regulations governing nondiscrimination conduct in government employment would be adhered to.

The demographic information indicates none of the alternatives would affect environmental justice within Oceana or Muskegon Counties.

(3.18) Irreversible and Irretrievable Commitment of Resources

(3.18a) Area of Analysis

This section refers to specifically to the resources that occur within the Project Area boundary. This area serves as the area of analysis for the effects discussion.

(3.18b) Effects Common to All Alternatives

Irreversible commitments are decisions affecting non-renewable resources. Such commitments are considered irreversible, because the commitment would deteriorate the resource to the point that renewal could occur only over a long period of time or at great expense. Commitments are also irreversible if the resource has been destroyed or removed. The loss of soil due to erosion would be an irreversible commitment of resources. However, due to the incorporation of Best Management Practices, Forest Plan standards and guidelines, and the conservation measures specified in this document (Appendix A), it is not anticipated that there would be any significant soil loss under any alternative from soil erosion. The loss of heritage resource sites resulting from accidental damage or vandalism would also be an irreversible commitment of resources. Conservation measures would provide reasonable assurances there would be no irreversible loss of heritage resources.

Irretrievable commitments of natural resources result in the loss of productivity or use of resources due to management decisions made in the alternatives. These are opportunities foregone for the period of time that the resource is unavailable. Under Alternative 1, there would be no irretrievable commitment of resources. Under Alternatives 2 and 3, of the 2,542 acres of savanna creation activities, there would be approximately 2,422 acres that would be permanently converted from a forested condition to a non-forested condition (the remaining 120 acres is already classified as open area). These forested areas would be removed from the commercial timber base and there would be a shift in ecosystem productivity as these areas undergo the slow transition to savanna. The commitment is irretrievable, rather than irreversible, as reforestation efforts could be made in these same areas for future inclusion into the commercial timber base.